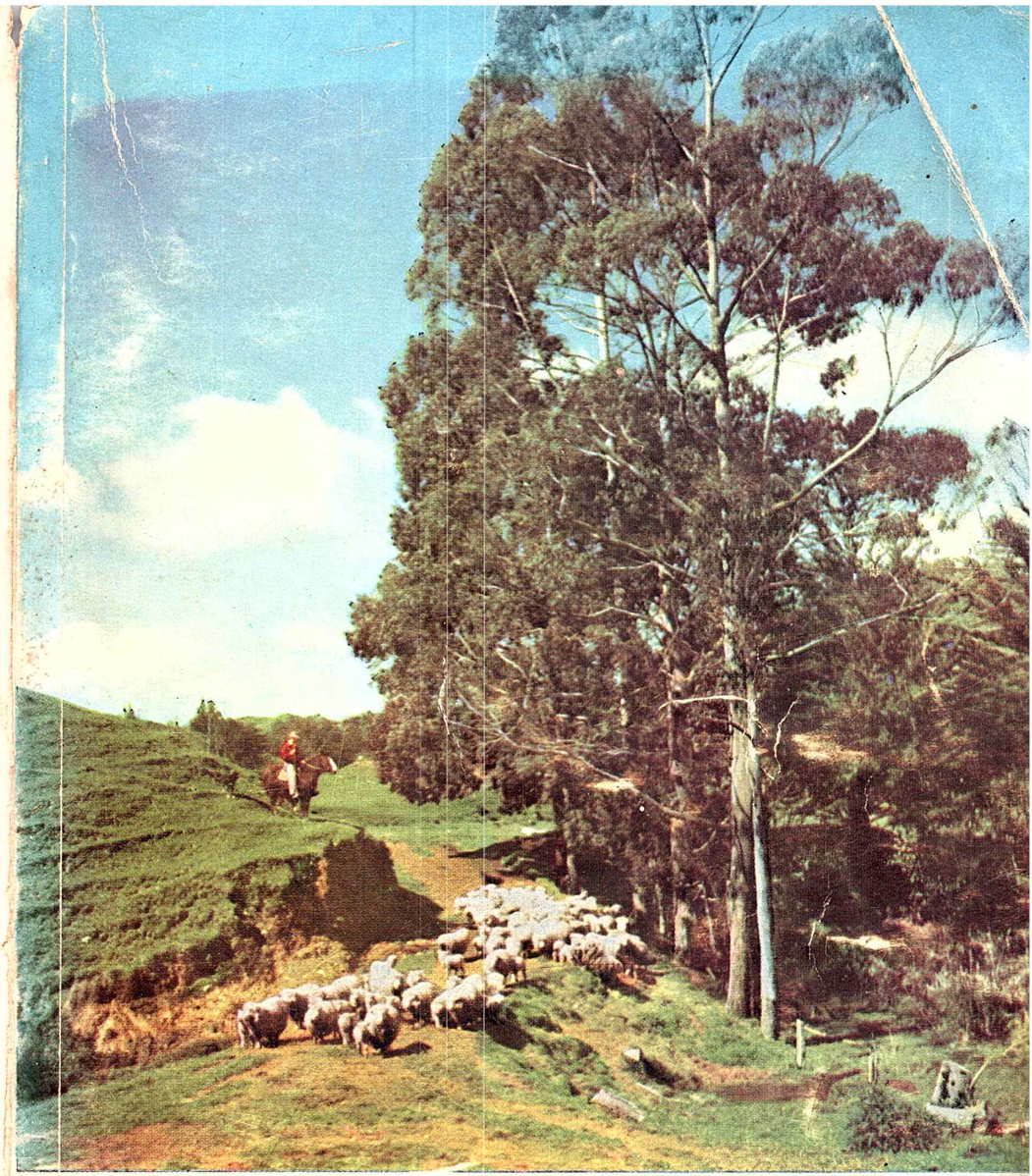
SHEEPFARMING ANNUAL 1956



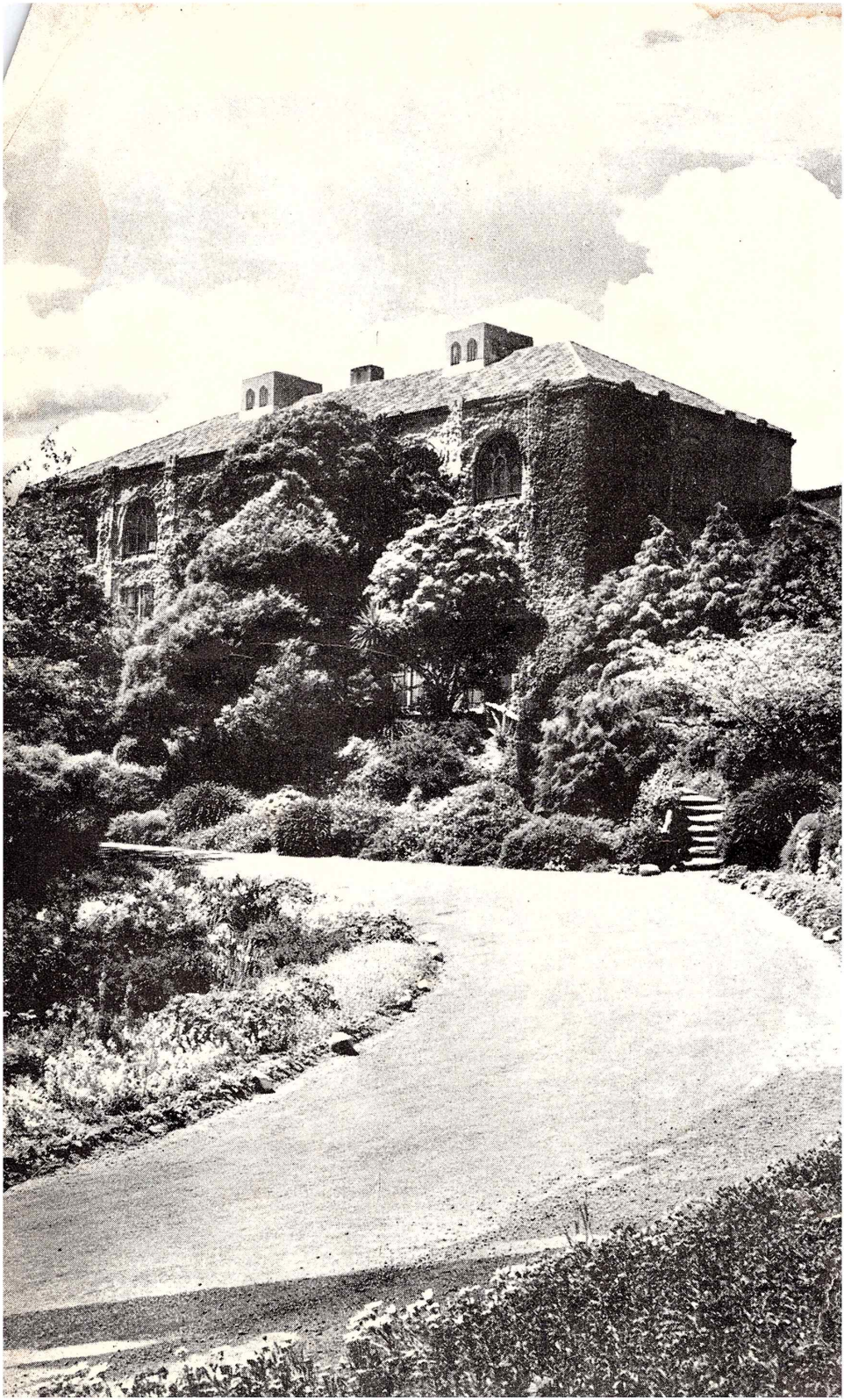
SHEEPFARMING ANNUAL

1956

MASSEY AGRICULTURAL COLLEGE
(University of New Zealand)

Ten Shillings

SHEEPFARMING ANNUAL
1956



SHEEPFARMING ANNUAL
1956

Including the Proceedings of the Nineteenth Annual Meeting of Sheep Farmers conducted by Massey Agricultural College, Palmerston North, from June 26 to 28, 1956

Published by

MASSEY AGRICULTURAL COLLEGE
(UNIVERSITY OF NEW ZEALAND)

September, 1956

Editorial work and production by
EDITORIAL SERVICES LIMITED

Printed by
WRIGHT & CARMAN LIMITED

Frontispiece: Massey Agricultural College, Palmerston North
(*Photo: National Publicity Studio*)

CONTENTS

CHAIRMAN'S ADDRESS ..... *G. S. Peren* 7

FACIAL ECZEMA:

Facial Ecezma Research ..... *J. F. Filmer* 11

The Control of Facial Eczema in Sheep *C. P. McMeekan* 21

BREEDING FOR QUALITY IN PASTURE PLANTS ..... *L. Corkill* 47

PROVISION OF ALTERNATIVE FEED WHEN PASTURES ARE DANGEROUS:

Silage and Hay: Harvesting and Storage in Relation to Quality ..... *R. H. Schwass* 57

Machinery for Silage and Haymaking ..... *M. W. Cross* 63

Late Summer and Autumn Crops ..... *G. S. Robinson* 71

Improved Crop Yields by More Efficient Use of Machinery ..... *M. W. Cross* 76

Planning for Alternative Feeds to Pasture ..... *N. Watson* 85

Modifications to Present-day Tillage Practices ..... *M. W. Cross* 96

ABOUT WORMS IN SHEEP *Daisy B. Filmer and E. A. Clarke* 109

REARING THRIFTY HOGGETS *E. A. Clarke and Daisy B. Filmer* 119

SOME ASPECTS OF THE NEW ZEALAND WOOL BOARD'S POLICY ON THE DEVELOPMENT AND PROMOTION OF THE INDUSTRY ..... *H. J. Wardell* 139

TEXTILE RESEARCH AND THE NEW ZEALAND WOOL INDUSTRY ..... *F. R. Callaghan* 149

THE DEVELOPMENT OF UNPLOUGHABLE GORSE-COVERED HILL COUNTRY ..... *E. Feist* 163

THE PROSPECT FOR BEEF ..... *J. D. Ormond* 183

RECENT ECONOMIC CHANGES IN ARGENTINA WITH SPECIAL REFERENCE TO BEEF EXPORTS ..... *H. B. Low* 203

DEVELOPMENTS IN THE USE OF AIRCRAFT AS AN AID TO FARMING:

Airstrips and their Installations ..... *A. D. Simpson* 215

The Use of the Helicopter in Weed and Pest Control ..... *E. C. S. Little* 220

Crop Spraying and Dusting and the Hormone Treatment of Weeds ..... *P. S. Ferens* 230

FARM DRAINAGE: SOME IMPORTANT DEVELOPMENTS, TOGETHER WITH RECOMMENDATIONS FOR THE MORE EFFICIENT MANAGEMENT OF DRAINED LAND *D. G. Bowler* 241

THE DEVELOPMENT OF SCRUB-COVERED HILL COUNTRY IN THE PATOKA DISTRICT, HAWKE'S BAY *W. H. Hartree, Jnr.* 251

Cover photo by National Publicity Studio.

ADDRESS BY CHAIRMAN

G. S. PEREN
(Principal, Massey Agricultural College)

As Chairman of the 1956 Meeting of Sheep Farmers, it gives me very real pleasure to record the largest attendance in the history of the nineteen meetings conducted at Massey College since 1933. This year nearly 600 farmers from all parts of the Dominion registered, and many more attended the special displays and demonstrations which have become a feature of the Meetings.

The success of the Meeting was, of course, due in large measure to those who read papers or in other ways gave their support, and I should like to express my thanks to them. Interest was no doubt also stimulated by the prominence given by the programme to the topical and important subject of facial eczema and the associated problems of sheep management when pasture is in a dangerous condition.

Those who attended benefited directly from participating in the discussion on these and the other valuable papers presented. I feel confident that publication of the proceedings of the Meeting in this volume of the Sheepfarming Annual, *though it cannot convey the full spirit of personal participation, will nevertheless make available to those unable to attend a great deal of real interest and value.*

* * *

FACIAL ECZEMA HAS BEEN VERY MUCH to the fore during the past autumn, and has probably been the principal topic of conversation among sheepfarmers. On a number of occasions I have heard the statement that more first-class research workers, the best that money can obtain, must be engaged for work on this problem, which, annually, is costing the country a mint of money—in fact, has reached the proportions of a national calamity. In the article on p. 11, Dr. Filmer has given a word picture of the work which has been undertaken, and has commented on the problems facing the research team at his disposal. I feel that I should point out the difficulties facing any institution in New Zealand which wishes quickly to obtain the services of an additional number of first-class men for any line of work whatsoever. It is clear that many farmers do not fully appreciate the problem, and it is essential that they should do so, since it is they who are vitally concerned.

The country has been told in no uncertain terms on a number of occasions of the losses of good men which have been steadily taking place as a result of the higher salaries being offered in other parts of the Commonwealth. The new salary scales, which I understand will be introduced shortly, will, I hope, help to stop the drift, but the point I want to make clear is that losses of first-class men—men of age and experience—cannot be made good with men of similar calibre, unless the salaries offered are at least as attractive, if not

more so, than those offered by their home countries. Why, otherwise, should they uproot their families, leave their homes and friends, and emigrate? Such salaries, however, pose a real problem in view of the present relationship between the salaries of our research workers and of the rest of the civil service. While this relationship exists, an almost insuperable hurdle must be faced. It is, therefore, futile to suppose that first-class men can be rapidly recruited merely by making more money available for research. I do want to stress this point, in view of the nature of so many of the remarks on this subject which I have heard.

It is true, of course, that young men can be obtained from overseas if they are offered fairly senior positions—positions for which they would have to wait for some years in their home countries. But such young men normally have their limitations, since the cream of their age group do not see the object of emigrating, as senior positions in their own countries will come their way in due course. Those who can be tempted may "grow into money," but they are rarely of the calibre to which I have heard farmers refer.

When it comes to recruits from within this country, a research station may be able to build up its team by recruiting young graduates in pure science, but usually finds it impossible to obtain experienced men without robbing some similar field of work. It will have a very limited chance of obtaining graduates in agriculture, as the output of the two Agricultural Colleges is so small.

Farmers must appreciate, therefore, and I cannot stress this point too strongly as it is vital that they should appreciate it, that the production of an efficient research team takes years of careful selection and building up, and the payment of salaries which will retain the men. Farmers cannot suddenly decide that since, say, the producer boards have the money, they can go on to the market and buy first-class men at a moment's notice, unless, of course, they are prepared to organize research teams outside the civil service and to offer not only very attractive salaries, but also permanent appointments. Even then the undertaking is a long and laborious business with many disappointments.

There is only one businesslike attitude to this problem to adopt, and that is to maintain a continuous watch on the situation, and to insist that the various branches of agricultural research are efficiently and adequately staffed. This is a job for farmers, as, in the first case, it is a matter of their own interests, although of vital importance to the Dominion as a whole. As has been pointed out on a number of occasions in the past two or three years, this country will find itself in the doldrums if it does not make every effort to increase its agricultural production. The matter, therefore, is removed from the realm of purely sectional interest. It would, however, be suicidal to "leave the job to the other fellow." The rest of the population is completely absorbed in its own problems, and, naturally, expects farmers to look after their own interests.

It may be argued that, as things are at the moment, we should be trying to economize. This statement has been made in connection with the establishment of a School of Veterinary Science. While heartily agreeing with this principle, I would point out that even in the worst times there is always a certain amount of money available for expenditure other than on administration, and that research is a "must," which should be given priority in the disbursement of even the most limited funds. The financial losses during recent years as a result of facial eczema, which must run into many millions, surely are evidence that this is an uncontrovertible fact. There is every justification, therefore, for farmers to close their ranks and make their voice heard on this matter amidst the clamour from the numerous pressure groups which always besiege a Government. But I do not think farmers will get very far unless they close their ranks and show a united front.

Reverting to my reference to the small output of graduates by the two Agricultural Colleges, I believe that the new salary scales will go a long way towards making agricultural science a more attractive profession, but salaries, by themselves, cannot be relied upon entirely to remedy the situation. Far more encouragement to young people to enter this field of work is very much needed, and this is where farmers can help. How many have suggested to their sons that they should take a degree in Agriculture? Probably very few; and yet a young fellow with a good brain and a farming background is just the type we want. This, I suggest, is another case where the farming community must make every endeavour to help itself. For example, there must be many farmers throughout the country who sit on school committees and educational bodies of one kind and another. They should use their influence to see that suitable young fellows are encouraged to take up agricultural teaching and research. This influence is very much needed, as there is a marked tendency amongst so many school teachers to encourage unduly the brightest of their young people to set their caps at careers provided by our rapidly growing towns and cities. Teaching and research connected with our primary industries must be allowed a fair share of our first-class brains, or this country will assuredly rue the day. However attractive a modern urban society may be to so many of today's population, it must always be remembered that New Zealand is fundamentally a small farming country, and that, in our endeavour to maintain a sound economy, we must be forever straining to obtain the most out of our farming industry.

As we intensify our farming—and intensify we must if we are to avoid the doldrums—more and more serious problems will arise. We must have efficient teams on hand to tackle them as they appear. The work will involve not only research, but the best of extension services. Unless, however, we can induce more men to enter the service, and hold them when we have trained them, we are heading for trouble.

MASSEY AGRICULTURAL COLLEGE

(University of New Zealand)

PALMERSTON NORTH, NEW ZEALAND

The College offers courses for:

THE DEGREE IN AGRICULTURE

THE DEGREE IN HORTICULTURE

THE DEGREE IN DAIRY TECHNOLOGY

and provides facilities for advanced study and research in various fields of agriculture.

It also offers diploma courses in:

SHEEP FARMING

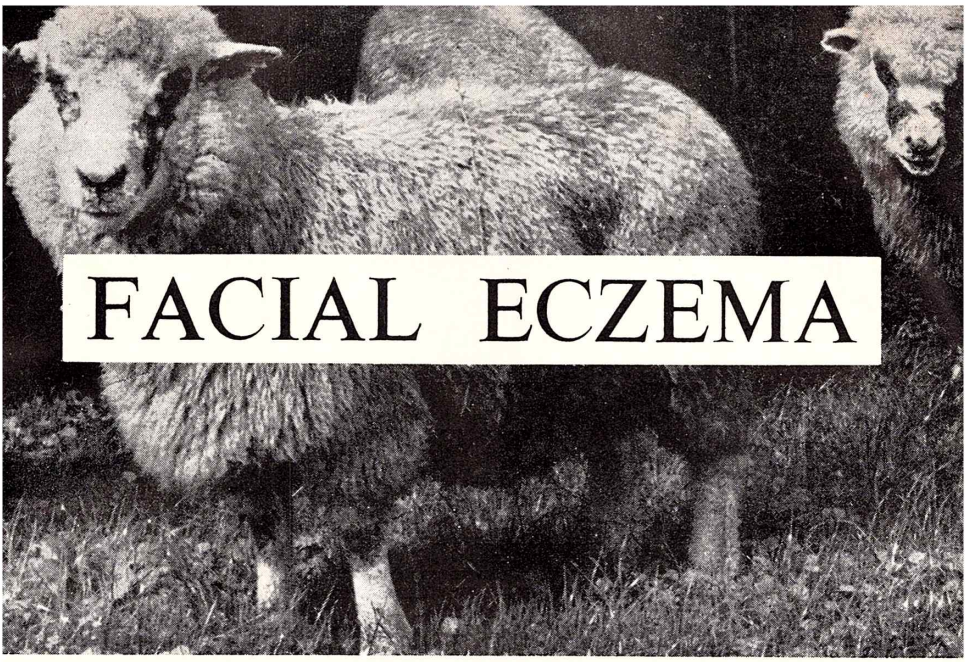
DAIRY FARMING

HORTICULTURE

WOOL AND WOOL CLASSING
(Both Professional and Farmers' Courses)

DAIRYING
(Buttermaking, Cheesemaking, Market Milk)

Full details are obtainable from the Registrar, Massey College, Palmerston North.



FACIAL ECZEMA

FACIAL ECZEMA RESEARCH

J. F. FILMER*

FOR MANY YEARS THE Department of Agriculture has stated that facial eczema can be prevented. The precautionary measures have been described in journal articles and Departmental bulletins, in the press, in broadcast talks, and in addresses at meetings. Warnings have been issued in the summers preceding all autumns in which facial eczema occurred. Such warnings were issued in the last two summers. Why, then, did disastrous and widespread losses from facial eczema occur during the last two autumns? Do farmers not know the Department's recommendations? If they know them, do they consider them wrong? Do they fail to carry out the recommendations properly? Do they deliberately weigh the chances and decide to run the risk of facial eczema rather than carry out the recommendations, or are the recommendations wrong?

Numerous recent letters and resolutions about facial eczema make it obvious that many farmers do not know or do not understand the programme of facial eczema research. It is proposed, therefore, to discuss what investigations have been made and what research is going on today; what facts have emerged from the investigations; and, finally, how the recommendations for prevention and treatment of facial eczema are based on those facts.

**Director, Animal Research Division, Dept. of Agriculture, Wellington.*

Facial Eczema is Not Infectious

Almost fifty years ago, the first efforts were made to transmit facial eczema from an affected to a healthy sheep by injecting material derived from the skin lesions. At various times since then healthy sheep have been injected with blood from affected sheep, have been drenched with stomach contents and bile from affected sheep, and have been penned with affected sheep. In no case has facial eczema been transmitted from one sheep to another, and there is absolutely no reason to believe that the disease is infectious.

The Pattern of Facial Eczema

By 1938 certain ideas about facial eczema had begun to crystallize. It was known that the liver was always damaged and the general type of the damage could be recognized. It was known that the skin lesions were due to photosensitization. Investigations in South Africa into a disease known as geeldikkop or yellow big-head had shown that the photosensitization was due to phylloerythrin, a substance formed from chlorophyll in the gut. In the normal animal this is excreted in the bile and passes out in the dung. In certain types of liver damage, the liver is unable to remove this substance and it accumulates in the blood and makes exposed or lightly coloured skin unduly sensitive to sunlight. Investigations in New Zealand have definitely proved that the skin lesions in facial eczema are also due to photosensitization by phylloerythrin. It was therefore certain that they were secondary to the liver damage, which can cause serious loss in condition without the appearance of skin lesions. It therefore became necessary to concentrate on the liver damage and to find out what caused it.

The Cause of Liver Damage

Over twenty plants are known to cause this type of disease in various parts of the world; it was therefore natural to look for a toxic plant in New Zealand. A careful search failed to reveal any weed or fungus which could be incriminated. The hypothesis was therefore evolved that one or more of the pasture plants became toxic under certain conditions. To prove this it was necessary to collect a sample of pasture and produce typical liver damage by feeding it to sheep which had never had any previous chance of getting facial eczema. This proved unexpectedly difficult and early attempts failed. Even when lambs were turned into a paddock in which facial eczema was occurring they failed to become affected. It thus became obvious that, if facial eczema was due to eating toxic grass, the grass was toxic for short periods only. It was no longer toxic by the time recognized symptoms developed in the sheep. Thus, it was necessary to collect grass not after but before symptoms appeared.

The collected grass had then to be kept until symptoms developed in the sheep. Finding a method of keeping the grass which was not likely to destroy the liver-damaging factor was not easy. Freezing, preserving in alcohol, boiling, and sealing in tins, were all tried. Finally, drying in a forced draught of hot air was adopted.

As liver damage could occur without any obvious symptoms, various liver function tests were used in an effort to determine when liver damage occurred. None of these proved reliable. Small sections of liver were removed from living sheep with a special instrument, but examination of these did not give a reliable indication of the liver damage.

After many trials a system was evolved which is essentially the system used today. Lambs which had been kept on crops which do not produce facial eczema were introduced into experimental paddocks every week and killed for liver examination after two to four weeks' grazing. Pasture was mowed and dried every day from the first rains in February until the end of April, and each sample labelled with the date of collection. At the end of the autumn it was possible to determine from liver examination during which periods pasture had been toxic. Unfortunately several years passed before significant liver damage occurred in the experimental lambs. However, in 1943 at Wallaceville samples of dried pasture collected in this way produced typical liver damage when fed to lambs which had never been in a paddock in which facial eczema had occurred. This has been repeated several times since then. As typical liver damage has never been produced in any other way, it may be confidently asserted that facial eczema is caused by eating grass in which a liver-damaging factor has developed.

The Search for the Liver-Damaging Factor

Since 1943 all efforts have been concentrated on determining what the liver-damaging factor is, and under what conditions it develops in the pasture. To permit accurate field observations, and to collect toxic pasture for chemical examination, special experimental areas have been used which were located first in the Waikato and Wairoa districts. Then, in 1945, the Department purchased an area of 65 acres at Manutuke, nine miles south of Gisborne, and converted it into an experimental station which is specially designed for the field study of facial eczema and the collection of toxic pastures.

Chemists have encountered many problems in their search for the liver-damaging factor. As facial eczema occurs only in the autumn, and only in some years, they must depend for their supplies of toxic grass on material collected during very short periods which, on the average, probably represent not more than one week per year. Of the many tons of dried grass collected, only a small proportion has proved sufficiently toxic to be suitable for chemical examination.

The purely chemical problems have been considerable. Perhaps the greatest of these has been the necessity to work with large quantities of dried grass. As the character of the liver-damaging factor is completely unknown, each extract which the chemists prepare must be fed to an animal to determine if it contains that factor. In the past lambs were used, and as much as 50 lb. of dried grass had to be used for a single test. Trials were, therefore, made with smaller animals, including rabbits, guinea-pigs, rats, mice, and chickens. It has now been

found that very young guinea-pigs suffer liver damage when fed toxic grass, and a test can now be made with about 1 lb. of dried grass. This has speeded up the work and very real progress has been made. The latest extracts contain only 1/4,000 of the original material in the grass, without significant loss of toxicity. In other words, these extracts contain the liver-damaging factor in very high concentration. It is confidently hoped that it will soon be identified.

Once this has been done, it should be possible to evolve a chemical test to determine the concentration of the liver-damaging factor in any sample of grass. This will enable the effect of environmental factors, such as climate, soil, fertilizer, and grazing management, to be determined accurately. It will also enable the pasture species which cause facial eczema to be identified with certainty. It should enable preventive measures to be evolved which are more practical and more certain than those at present advocated. It might even make it possible for plant breeders to provide suitable pasture species which will not produce facial eczema under conditions which render our present pastures very dangerous.

These are the reasons which have prompted the concentration of all our efforts round the identification of the liver-damaging factor. The nature of the work makes it impossible to employ a large team of chemists. However, at present two of our ablest chemists are employed full-time on the work and nine other officers are employed full-time assisting them or providing grass for them, or studying other phases of the facial eczema problem. When the liver-damaging factor has been identified, a larger team of chemists will probably be required and every effort will be made to employ them.

Concurrently with the efforts to identify the liver-damaging factor, extensive observations have been made at Manutuke, Ruakura, and on a number of affected farms, to obtain an understanding of the conditions under which facial eczema occurs in the field.

Facts About Facial Eczema

The following well authenticated facts have emerged from facial eczema research to date.

¶ The liver damage is due to a liver-damaging factor which develops in pasture during some autumns.

¶ The photosensitization is due to phylloerythrin.

¶ Liver damage can occur without photosensitization, but photosensitization does not occur without the liver damage.

¶ Liver damage sometimes develops slowly and may progress after consumption of toxic pasture ceases. This has been demonstrated clearly in both sheep and guinea-pigs and explains why lambs sometimes show symptoms of facial eczema after transfer on to rape or other crops which do not produce facial eczema.

¶ Facial eczema occurs only in the autumn; generally between February 1 and the end of April. However, some cases occurred in January this year.

¶ Facial eczema outbreaks occur only in years when some part of the summer or autumn is hotter than normal—*e.g.*, in 1955 the second half of February was from 4° to 10° above normal and the first half of March was from 3° to 7° above normal in most North Island districts. In 1956 temperatures were from 3° to 7° above normal in January and from 4° to 8° above normal in April.

¶ In hot years facial eczema follows warm autumn rains.

¶ There may be several dangerous periods in one autumn.

¶ Facial eczema does not always occur under the conditions which usually produce it.

¶ White clover, rape, choumoellier, turnips, and kale have never been known to produce facial eczema.

¶ Perennial ryegrass and short-rotation ryegrass have been proved to produce facial eczema.

¶ Facial eczema has occurred on pastures dominant in browntop, danthonia, and lucerne; it is not known whether these species produce facial eczema or whether the disease was caused by the relatively small amounts of ryegrass present.

How Can Facial Eczema Be Prevented?

Bearing in mind the knowledge that we now have about facial eczema, how can the disease be prevented? The principle underlying prevention is quite simple, though in practice its application may present many difficulties. As facial eczema is caused by eating toxic pasture, the obvious way to prevent it is by preventing stock from eating toxic pasture. This may be done in a variety of ways, but this principle must be the basis for all preventive measures.

In planning preventive measures, each farmer should ask himself the following three questions:

(1) In what paddocks on my farm are pastures likely to be toxic?
(2) When are they likely to become toxic?
(3) What am I going to do during the dangerous period to ensure that my stock do not eat toxic pasture?

How can farmers find the right answers to these questions? Let us look at them in turn.

What Paddocks are Dangerous

Any paddock in which the disease has occurred should be regarded as dangerous. Any other paddock with similar pasture should be regarded as potentially dangerous, even though the disease may not have occurred in it previously. It is not safe to assume that the disease will not occur on a particular farm merely because it has not occurred there previously. In an autumn like that in 1956, it is not even safe to assume that a district is safe because it has previously escaped the disease. A few cases of facial eczema occurred at the Wallaceville Animal Research Station this year; this is certainly

the first occurrence of facial eczema at Wallaceville since the station was established in 1905.

In very dangerous years it is doubtful if any farm in the North Island can be regarded as completely safe. In most years, however, previous experience will serve as a useful guide in determining the dangerous paddocks. Due consideration, however, must be given to the possible effect of topdressing or pasture establishment in paddocks which have previously been safe. If there is any doubt it pays to play safe. Giving facial eczema the benefit of the doubt can prove a very expensive gamble.

When is Facial Eczema Likely to Occur?

In all years in which bad outbreaks of facial eczema have occurred there have been periods during summer or autumn which were hotter than normal. For this reason the N.Z. Meteorological Service supplies the Department of Agriculture every year, at fortnightly intervals, from the beginning of November to the end of April, a summary of air and soil temperatures from eleven widely distributed weather recording stations. This enables the Department to issue general warnings when temperatures are unusually high. It is interesting to note that these high temperatures generally occur over a wide area and not just in one district. The record for the second half of January, 1956, is a good example of this, and the data are given in Table 1.

In such a year facial eczema is to be expected if warm rains fall in the autumn. The advent of such rains, however, can vary markedly in small areas. Therefore, while a general warning based on temperatures can be issued, each farmer must decide for himself when to take precautions, and must be guided by the rainfall on his farm. He can safely depend on the nearest temperature-recording weather station—of which there are 82 in the North Island—for temperature

Table 1: Deviation of Air and Earth Temperatures From Normal; January 16 to 31, 1956.

Station	Air Temperatures (°F.)	Earth Temperatures (°F.)			
		4in.	8in.	1ft.	3ft.
Auckland	+4.6	.	.	+2.6	+0.8
Ruakura	+4.1	+4.3	+4.1	+3.2	+0.8
Gisborne	+6.2	+4.9	+4.8	+4.7	+2.1
New Plymouth	+5.2	+5.0	+3.7	+3.5	.
Napier	+6.3	.	.	+1.4	+2.3
Hastings	+6.6	+3.3	+1.9	+2.2	.
Palmerston North	+3.3	+3.6	+3.8	+4.6	+4.3
Waingawa	+6.0	.	.	+2.9	.
Wellington	+3.7	+2.7	+3.6	+2.6	+2.7
Nelson	+5.2	+3.3	+2.5	+2.0	+1.5
Blenheim	+7.1	+7.1	+5.1	+5.3	.

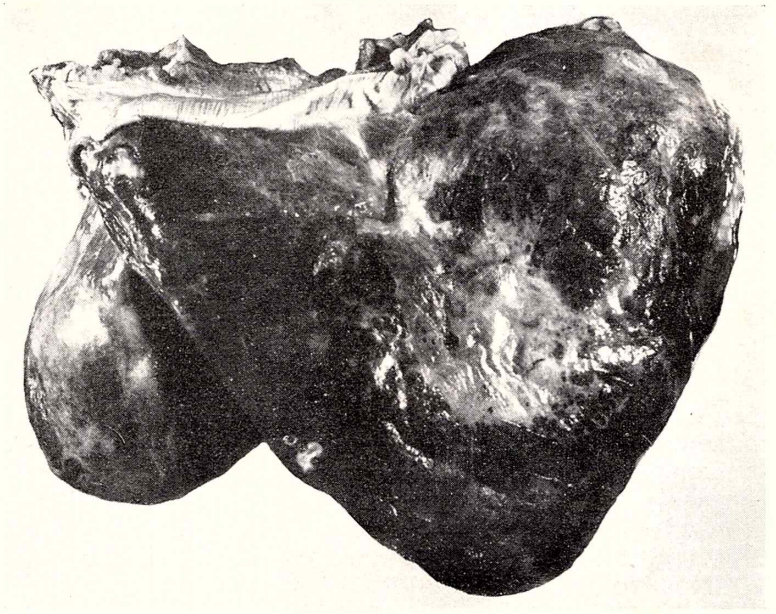


Fig. 1: Liver badly affected with facial eczema, showing gross distortion and extreme development of white fibrous tissue.

records, but he must observe rainfall for himself. A rain gauge will be more valuable to him than a thermometer.

WHAT PRECAUTIONS SHOULD BE TAKEN?

In deciding what precautions to take, it must always be remembered that the object is to prevent stock from eating toxic grass. This can be done by feeding them on safe crops, or by concentrating them on such small areas that the amount of grass eaten is reduced to a very low level, and feeding them on hay or silage. The concentration should be such that the ground is bare at the end of twenty-four hours. Details of precautions to be taken, and results that have been achieved, will be given by Dr. C. P. McMeekan (see p. 21).

What To Do When Facial Eczema Occurs

Prevention is always better than cure, but the quoting of such platitudes is of no help to a farmer who is wrestling with an outbreak of facial eczema. He wants answers to the following three questions:

(1) Is there any cure for facial eczema?
(2) What stock should be sent to the works?
(3) What should be done with stock that are kept?

IS THERE ANY CURE FOR FACIAL ECZEMA?

The answer is "No." Because so much publicity has been given to alleged cures it seems desirable to explain why treatment with drugs is not likely to be effective.

In facial eczema we are dealing with a damaged liver. The liver is one of the most complicated organs in the body. It consists essentially of a multitude of cells arranged in small clusters. Each cluster is connected with four different systems of tubes. The arteries bring to the liver cells all the substances that are required for their nourishment. One system of veins brings to the liver cells the food which has been absorbed from the gut. The liver cells divide this into useful material, and waste or harmful material. The useful material is taken by another system of veins to the heart, which pumps it to all parts of the body. The waste and harmful material is taken by the bile ducts to the gut and passed out in the dung. This is, of course, a much over-simplified description of the structure and function of the liver.

In facial eczema, damage occurs in the small bile ducts, which may be completely destroyed. The liver immediately forms new bile ducts, but these can function only if they are connected to both the liver cells and the larger bile ducts. In mild cases of facial eczema this happens and the liver is able to function sufficiently well to enable the animal to recover and lead a normal life, though the scars left by the disease can still be detected in all but the mildest cases. In bad cases the damage is so severe that many of the new bile ducts cannot function. The liver cells die and are replaced by fibrous tissue. The larger bile ducts become swollen and their walls are thickened. This is well illustrated in the accompanying photographs of casts made from normal and badly damaged livers (see Figs. 1, 2, 3). Badly damaged livers are distorted in shape, much harder than normal, and their structure is obviously disorganized. It is inconceivable that anything could restore such a liver to its normal state. Yet we are asked to believe that there are not just one but a number of cures for facial eczema. These include ragwort, vegetable oils, the common blue bag, colour therapy, and the potions of a Chinese herbalist. If any of these will cure facial eczema, then truly the age of miracles is not past.

What Stock Should be Slaughtered?

The question is often asked: "Is there a test which will show how badly a sheep's liver is affected and thus whether it is worth keeping?" Unfortunately, there is no such test, and it is unlikely that one will become available. A liver function test can only measure a particular liver function at the time the test is applied. Like most organs of the body, the liver has a large reserve capacity, and a relatively small section of the liver can perform most functions adequately. A test gives no indication of the extent of liver damage and it can give no indication of what will happen in the future, following resolution or some special stress such as lambing. Even an inspection of the liver will not give this information, because the changes in structure go on after feeding on toxic pasture has stopped.

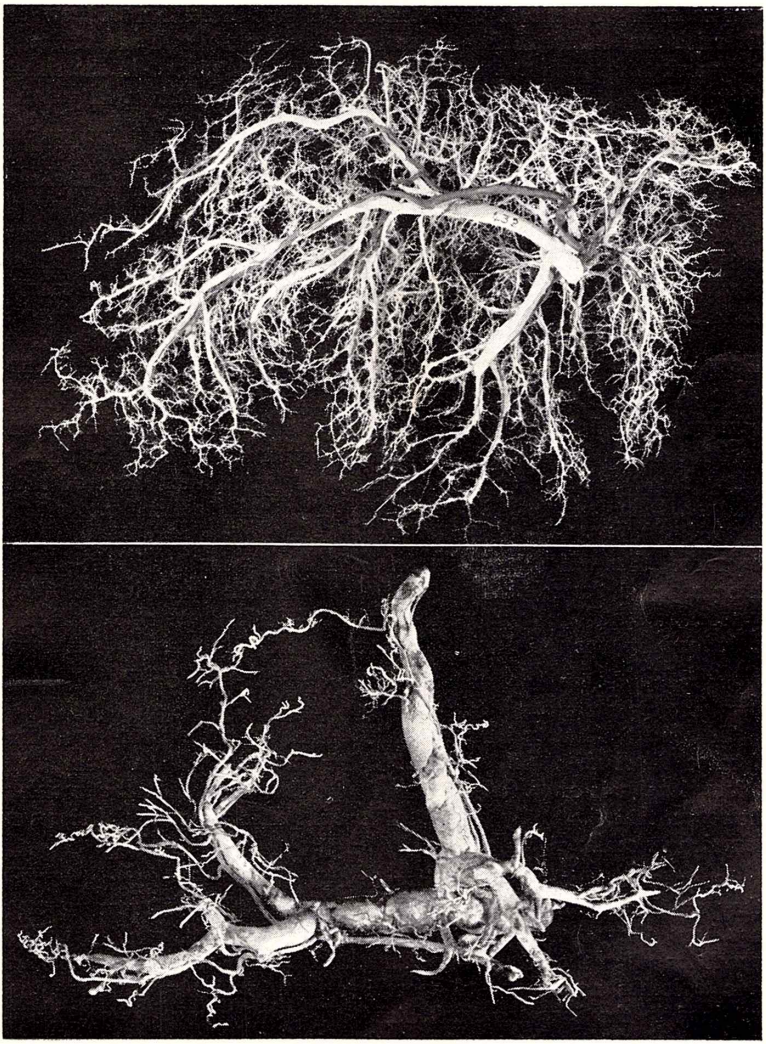


Fig. 2:

Top: *Cast from normal sheep's liver. The white vessels are the bile ducts and the darker vessels the hepatic artery and its branches.*

Bottom: *Cast of bile duct system from the liver shown in Fig. 1. Most of the small bile ducts have disappeared and the main ducts are grossly enlarged. The smaller vessels running parallel to the main bile ducts are the hepatic artery and its branches.*

The animal's general condition is the best indication of how the liver is functioning. If sheep lose condition rapidly and are obviously very sick when removed from toxic pasture and placed in the shade, they will probably not recover and should be slaughtered. In general, however, a conservative policy pays. If protected from eating any more toxic pasture, a large percentage of sheep will recover sufficiently to grow a reasonable fleece, and will regain sufficient condition to enable them to be killed for mutton. This can happen even when the liver is grossly damaged. Large numbers of such livers are found in fat ewes slaughtered in the summer following a bad outbreak of facial eczema. It is wise to give all but the worst cases a chance to recover.

How Should Stock Affected with Facial Eczema be Treated?

The measures which have been recommended for preventing facial eczema apply with even greater force to stock which are affected with facial eczema. It is of the utmost importance that livers already damaged should not be further damaged by another dose of toxic pasture. Skin lesions will heal rapidly if affected animals are placed in the shade. If shade is provided at the stage where swelling only has occurred, this will subside in a few hours. Naturally, if the lesions have reached the scabby stage, healing will take much longer. Cows whose teats are badly affected should be dried off at once. This not only enables the teats to heal more quickly, but it protects them against severe mastitis, which may be caused by germs from the affected teats entering the udder during milking.

Treatment, then, consists essentially of shade and protection against further doses of toxic pasture. Under such conditions even badly affected animals often show a remarkable recovery. It is not surprising, however, that the badly affected liver fails under the special stress of lambing or calving.

In general, it is a good policy to quit recovered ewes as soon as they are fat, and not to breed from them. If affected pregnant ewes are kept, they should be observed carefully at lambing. If they lose condition, then they should not be mated again. On the other hand, if a ewe lambs normally and rears her lamb well she can safely be retained in the breeding flock. Affected cows appear to stand up to pregnancy and lactation rather better than ewes, but some of them find the strain of calving too great, and this should be kept in mind at culling time.

In conclusion, I can assure you that research will go on until the liver-damaging factor has been identified, and the best possible means of preventing facial eczema have been discovered. In the meantime, farmers should always "play safe" when trying to prevent facial eczema; it is better to take needless precautions twice than to suffer one bad outbreak of facial eczema. If an outbreak does occur, a conservative policy should be adopted. Give sheep a chance to recover, but do not ask too much from a ewe which has recovered.

Sheep will maintain condition on 1 to 2 lb. of good quality hay per day. Photo taken after six weeks' confinement.

THE CONTROL OF FACIAL ECZEMA IN SHEEP

C. P. McMEEKAN*

IN THE PREVIOUS PAPER Dr. J. F. Filmer has provided a comprehensive account of our present knowledge of facial eczema. He has emphasized that, while the disease is not curable, it is preventable. This paper describes how the farmer can protect his stock if he wants to. My only qualification for acting in the role of adviser in this connection is that it has been my responsibility over the past 13 years to protect the sheep under my charge at the Ruakura Animal Research Station. During this time over 3,000 research sheep each year, equally important to Ruakura and to the farmer, could not be permitted to contract the disease.

During five years of the period it was considered that no risk of facial eczema existed. In those years no precautions were taken and there were no outbreaks either at Ruakura or in the Waikato. During eight of the years, however, conditions were potentially dangerous and precautions were taken. In five of these, eczema did occur on a wide scale throughout the district. The precautions were completely successful. Although tens of thousands of sheep were lost in the Waikato during these five outbreaks and although Ruakura pastures were definitely toxic at these times, no animal to which the preventive measures were properly applied was affected. Over the years Ruakura has accepted the responsibility of direct advice to many farmers in the area owning collectively at least twenty times more sheep than there are on Ruakura. On these properties, too,

**Superintendent, Ruakura Animal Research Station, Dept. of Agriculture, Ruakura.*

where instructions were carried out to the letter, no losses from facial eczema occurred.

This record does not make me an expert in facial eczema control. It should be regarded rather as an example of the fact that, if a farmer accepts the warnings of the Department of Agriculture as to the likelihood of eczema occurring in his area in any particular year, and if he conscientiously and carefully applies the recommendations of the Department, he can protect his flocks.

The Principles of Control

Research has shown that the disease is caused by a liver-damaging toxin sometimes present in the vigorously growing pasture of late summer and early autumn. The basis of control is, therefore, surely obvious. *If sheep are prevented from eating toxic pasture they cannot possibly contract the disease.* The position is just as simple as that. The only complications are when, how, and for how long, must sheep be prevented from eating potentially dangerous pasture. It is only in respect to these three questions that we still have a great deal to learn before control is as easy as we would all like it to be. Right at the outset, however, it must be stressed that effective control will always be a matter of efficient management; that the disease is one that we have to learn to live with by increasing the efficiency of this management; and that all that can be expected from future research is an increase in the accuracy of prediction as to when any particular pasture is dangerous, how long it will remain dangerous, and how alternative management techniques affect the overall efficiency of control.

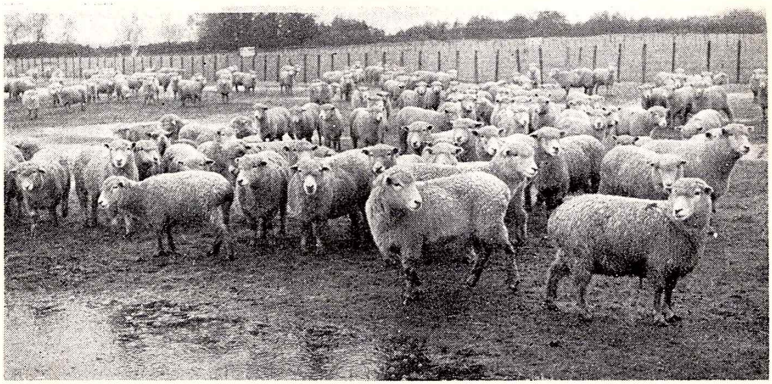
When Should Precautions be Taken?

This is the first key question. It is easy to answer. *They should be taken in those seasons when a district warning has been issued by the officers of the Department of Agriculture; they must be taken as soon as the first rain falls after the issue of this warning; they should be taken where pastures have never dried out but are still green, as well as when they have been dried out by summer conditions; they should be taken independent of the type of pasture on the farm.*

These answers can be considered in more detail.

District Warnings

As a result of close examination of meteorological data for the whole of the North Island each summer, the Department of Agriculture officers in each district are instructed to issue the appropriate facial eczema warning if conditions look dangerous in their areas. Because the precise conditions responsible for the growth of toxic grass are not yet fully understood, this warning errs on the conservative side, so that quite often it has been given for seasons when the disease did not occur. However, in no season when eczema has occurred in the most eczema-susceptible districts has the warning not been given. In the Waikato, for example, reference has been made to the fact that Ruakura took precautions in three years when eczema



Sheep confined during extremely adverse weather conditions came through well.

did not occur and in five years when it did. It will be clear, therefore, that at present precautions will be taken more often than are really necessary. The argument of some farmers that, because we often cry "wolf" without real cause, we know nothing about the disease is poor consolation when they wake up one day to find that disregarding the warning has cost them the whole of their flock.

Action after Rain

The second point to note is that actual precautions should be taken as soon as the first rain falls after the warning has been issued. Rain is the trigger which sets off the chain of events leading to the appearance of the disease in the flock. A heavy fall is not necessary. Any rain which produces definite growth in the pasture is enough.

When less was known of the disease than we know at present, it was thought that pastures had to be thoroughly bared down and dried up before they would produce trouble. For many years, however, we have known this to be untrue, though this information seems to have taken a long time to filter down to the farmer in the field. Facial eczema has occurred on pastures that have remained green all summer as well as upon those that have dried out. It has occurred on long pastures as well as upon short. It has occurred on dairy-type pastures as well as on those short-grazed continuously by sheep. It has occurred on irrigated pasture. Farmers, therefore, should not be lulled into a sense of false security because their particular property has remained green.

Type of Pasture

Precautions must be taken, too, independent of the botanical composition of the sward. Because our research team has been able to incriminate definitely only perennial ryegrass and short-rotation ryegrass, by extracting the liver-damaging substance from these two grasses, it has been assumed that other species of pasture plants are safe. This is not necessarily true. In practice, facial eczema can occur

to quite a serious degree on pastures that are dominant danthonia, dominant Yorkshire fog, dominant browntop, dominant cocksfoot, and dominant paspalum, as well as upon dominant ryegrass swards. It can occur and it has occurred on pastures on virgin bush burns. It has occurred on pastures that have never been topdressed with any kind of artificial fertilizers. It has occurred at altitudes of up to 1,500 ft. It has occurred on pastures topdressed annually with the trace elements, copper and cobalt, as well as on soil types that have never seen these additions. It has occurred on almost every variety of soil type of the North Island, including new pastures on raw peat.

It is, of course, possible that ryegrass is the only culprit, and that the disease exists on widely different kinds of swards like these because practically no pasture in the North Island is completely devoid of ryegrass. We will not know the answer to this, however, for some time. When we do, and if some pasture grasses can be classified as safe, control measures may become easier.

The summation of all this means that no pasture in any district for which the facial eczema warning has been issued can be considered safe. Precautions must thus be taken independent of the type of pasture on the farm.

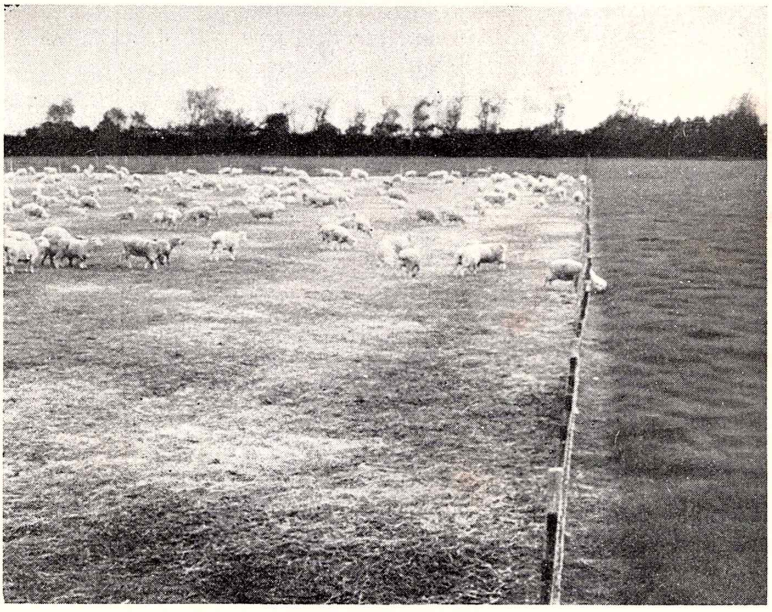
Before leaving the question of when precautions should be taken, it is vital to appreciate that the particular measures must be repeated on each occasion in any one season when renewed warm rain falls under high temperature conditions. This point will become clearer when the third issue—how long—is discussed.

It is equally vital, too, to take precautions at subsequent danger periods, even with a flock in which the disease has appeared. In most outbreaks several separate periods of grass toxicity occur. A sheep with a slight degree of liver damage from the first wave of toxic grass can become a complete loss if subjected to a second or a third dose of poison.

How Should Precautions be Taken?

Since the vital principle in control is the prevention of sheep eating any grass containing the liver-damaging substance, alternative feeds must be provided. *The most obvious way is to provide a crop for this purpose.* We know all the cruciferous crops, both root and green feed, do not produce eczema. Rape, kale, choumoellier, turnips, and swedes are all perfectly safe alternatives to pasture in a facial eczema year. Quite obviously, the best insurance policy the sheepfarmer can have, if he is located in a very dangerous area and if he is sincere in his desire to protect his flock, is to grow a crop.

To the stud sheep breeder and the man who is rearing hoggets, a crop is almost essential if complete safety is desired. Alternative methods suffer several disadvantages when applied to very valuable animals or very young sheep. Crops, however, are not safe if they are contaminated by a large proportion of pasture weeds, if extensive



Not secure enough. Fencing of holding paddock must be proof against grazing adjoining field of potentially dangerous grass.

headlands carrying pasture are unfenced from the stock on the crop, if uncropped areas of the field remain in pasture on steep faces and the like, and if the fences are not sufficiently good to keep sheep on the crop. Where eczema has apparently occurred in sheep on a crop, it is due to one or other of these factors, or to the fact that sheep have contracted the disease prior to going on to the crop. Since the external symptoms of facial eczema do not necessarily appear for some weeks, if at all, this is most commonly the explanation of crops apparently failing to protect stock.

All the arguments against the annual provision of a crop on the sheep farm are fully appreciated. Probably few have criticized more vigorously than I have the economic weakness of cropping or stressed more vigorously the basic economy of the completely grassland system of farming in New Zealand. However, the crop is the obvious choice for the farmer handling valuable stock and wishing to rear his hoggets with certainty in districts where facial eczema is a frequent hazard.

Because so few sheepmen do grow crops as a policy, we have been forced to develop alternative control systems. This brings me to the so-called "shutting-up" method. Remembering again the principle that protection is possible only if the sheep are prevented from eating any grass, *we recommend that the sheep must be confined on a bare paddock at the rate of two to four hundred per acre and kept there*

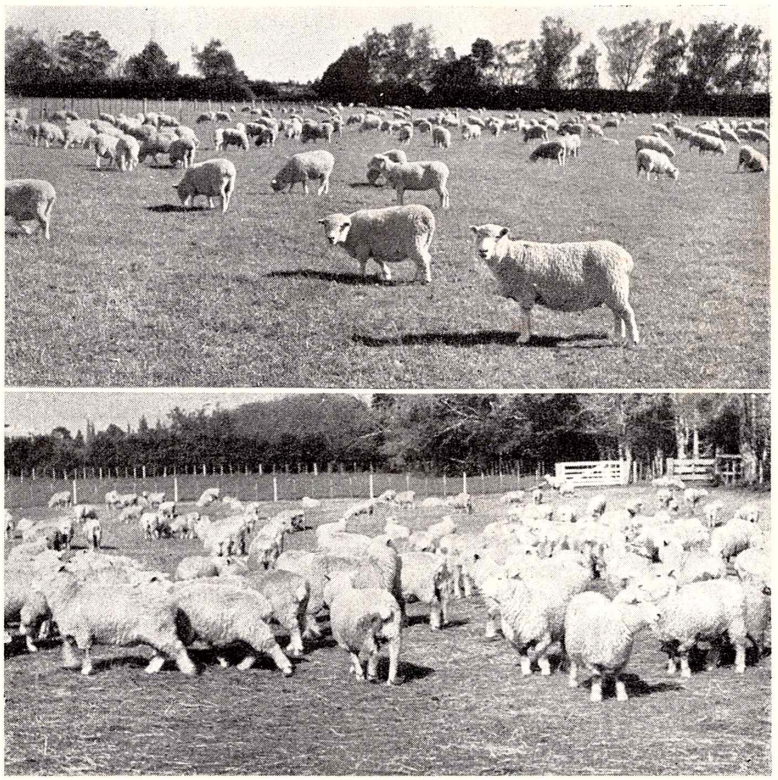
as long as the danger period lasts. While so confined they should be fed supplementary feed. The most practical type is hay, which should be fed at the rate of one to two pounds per breeding ewe per day.

At one time we recommended a shutting-up rate of at least 100 per acre on a bare paddock. From bitter experience we have found that this was too frequently interpreted by farmers to mean 50 to 60 per acre, on a paddock carrying quite a substantial amount of grass. To be sure rather than sorry, therefore, we now recommend at least 200 and preferably 400 per acre, so that there can be no mistake.

Shutting up in this way, of course, means shutting up. It does not mean that the farmer should get sorry for his sheep and let them out for half an hour's grazing on the roadside or on to a paddock of long feed. There is no more certain way than this of guaranteeing the appearance of the disease in a bad year. As has often been stressed to farmers, it is much more humane not to be sorry. This technique is often considered too difficult, even by the lowland farmer, on the grounds that he has no paddock small enough to shut sheep up. The objection is not valid, since a roll of netting round the water trough in any field will provide a completely satisfactory enclosure, and can be adjusted to fit any sized flock and adapted to handle a number of separate flocks on the same farm.

As an alternative to hay feeding, any ration which the sheep can be persuaded to eat can be used. Grass silage makes a useful addition to hay but is not usually sufficient in itself since few sheep can be persuaded to eat enough silage to permit them to maintain their body weight. Concentrates, including proprietary nuts specially prepared for sheep, may also be used, though they are naturally far more expensive than hay, and often it is more difficult to train sheep to eat them. It is not usual to recommend the use of such purchased feeds as many farmers criticize even the hay technique on the score of cost. This latter criticism, of course, is quite ridiculous, since a bale of hay per ewe has proved sufficient to protect sheep over the longest periods of shutting up so far experienced, and since the gains in pasture feed saved for winter use far outweigh the value of the hay fed.

The method is, of course, very much easier on the lowland fat-lamb farm, or on farms of easy contour, than on the more difficult hill country. This applies both to the use of crops and to shutting up on hay. On hill country, few farmers grow crops and few cut hay for obvious reasons, yet with modern methods there are not very many hill country farms in the facial eczema districts on which a limited area of crop, sufficient for facial eczema purposes, could not be grown, and from which a reserve supply of hay could not be cut. Ewes on hill country are more often set-stocked on an extensive basis than rotationally grazed in mobs, so that frequent mustering to permit precautions to be taken in a facial eczema year is extremely difficult, and often impossible.



Top: *Not tight enough. 50 sheep per acre leave too much grass after 24 hours and give too much regrowth.*

Bottom: *Tight enough. 300 sheep per acre keep grass intake to a negligible amount.*

Yet the development of more rational systems of controlled grazing would not only increase overall efficiency on the hill country farm, but would make our facial eczema control measures very much easier.

The shutting-up technique, of course, is not suited to weaned lambs unless these have been taught, from example by their mothers, to consume supplementary dry feed prior to weaning. The weaned lamb that has been reared entirely on milk and grass will starve on a hay diet. Unless a crop is used for weaned lambs and hoggets, these animals cannot be adequately protected. For this reason, our advice to the fat-lamb farmer without crops in an eczema district is to so organize his farming operations that the majority of his lambs have either been drafted, or are fit to draft, by the time the first risks of eczema appear in February. All lambs on the property that will kill should be drafted as soon as any serious risk exists. Unkillable lambs should be scattered over as large an area of the farm as is practical and on what look like being the safest pastures. These

pastures will be those with the rankest growth and with the lowest amount of ryegrass. Since it frequently happens that many paddocks on the one farm are safe while others are dangerous, this dispersal of young lambs avoids the risk of trouble in some of them. On hill country where hoggets have to be reared, the problem is not so easy and I can only repeat that the provision of a crop for such stock is the best guarantee available.

Hoggets often do not grow well on crops in February-March, but they can be held to come away rapidly again in winter when mature, safe pasture is available once more.

In the event of no crop being available or possible, the best advice than can be given is to scatter the hoggets thinly on a specially prepared hogget area where the feed has been allowed to come away long, and where response of pasture growth to summer rains is not very good. A paddock with a southerly aspect meets this specification. It must be appreciated, however, that while this is the best that can be done in these circumstances, eczema cases can occur since the stock do have access to grass. The method is dangerous.

How Long Must Precautions Be Maintained?

This is the most difficult practical question facing the farmer in facial eczema control. The decision as to when to take precautions is not a very difficult one to make, but the decision to take the risks attendant on releasing the stock to grass can be a very worrying one. Unfortunately, no hard and fast rule can be laid down, other than to say that it has been our experience that *pastures remain dangerous until there has been a definite change in weather conditions which have produced a visible change in the character of the new pasture growth.* This change in weather can be either in the direction of very hot, dry conditions or very cold conditions, both of which result in a "hardening" of the soft, fresh growth. Most observant farmers will know what is meant by the term "hardening." It is regrettable that we are not able to define it in more exact terms. In practice, our own policy has been to maintain the precautions until this definite change in the weather and feed occurs, and to wait at least an additional two days for good measure, before releasing the sheep.

The actual time over which precautions have to be taken is thus completely dependent upon weather conditions. There may be several danger periods in the same season. For example, in the 1954-55 season in the Waikato, we took precautions on four separate occasions, for periods varying from 5 to 8 days. In the 1955-56 season, which has been easily the most difficult that we have experienced, Ruakura sheep were confined on eight separate occasions, the period varying from 2 to 29 days, involving a total shutting-up time of 55 days. This is a maximum figure, including the day of confinement and the day of release.

From what has been said, it will be obvious that precautions have to be taken each time fresh, warm rain occurs in an eczema season,

and maintained until such time as is required for a change in weather to produce a more mature, harder type of feed. For this reason it is not possible for the Department of Agriculture to advise when pastures are safe on any particular property. This decision is and must be the responsibility of the man on the spot. It also means that it is unreasonable to expect that the precise shutting-up dates and release dates which were used on the Ruakura farm will also work on a farm at Morrinsville, Rotorua, Te Puke, or Hastings. Yet Ruakura receives literally thousands of telephone calls from all over the country in a facial eczema year asking whether or not the pastures on the inquirer's farm are safe. As was said earlier, facial eczema is a disease that the farmer has got to learn to live with. Farmers must appreciate that the responsibility of deciding when their particular pastures are dangerous and when they are safe rests upon their own shoulders. All that we can do is to provide a general guide.

The Basis of These Claims

It may well be asked why we are so certain that the control techniques which have just been described will work. The fact that Ruakura flocks have been protected from the disease is in itself no guarantee, as there are many examples of farms in most eczema-susceptible districts where the disease has never occurred, and where no precautions have ever been taken. In fact, this situation has given us some of our greatest headaches in persuading farmers that we do know something about eczema. A few prominent farmers in some districts have openly ignored all warnings and publicly boasted that their failure to take precautions has never got them into trouble. Fortunately for younger men, who cannot afford to be so foolhardy, many of these gentlemen did get caught last year, with the result that some of our greatest critics in the past are today our somewhat reluctant adherents.

However, this in itself is not enough. We are sure the precautions work, because in each year that facial eczema has existed in the district and has not occurred in the Ruakura flocks, it has affected what we call our "guinea-pig" sheep. These are sheep that are allowed to free-graze over the property at the same time as the major flock sheep have been confined. In addition, we have had an even more careful look at the efficiency of the control system. We have taken a flock of 600 ewes, divided it into two, controlled one half and allowed the other half to free-graze in adjoining paddocks. We have then slaughtered the whole of the uncontrolled flock. We found that, in addition to clinical cases, every ewe has had a severely and progressively damaged liver. We have also slaughtered the whole of a 300 ewe control flock, since the disease may manifest itself only in liver damage and not at all in external symptoms. In this way we have shown that the proper confinement of sheep from toxic grass does give complete protection both from liver damage and from clinical eczema.

Criticism of the Shutting-up Procedure

A commonly expressed criticism is that Ruakura's preventive treatment is "worse than the complaint." This is based upon the erroneous assumption that ewes will starve on a diet of hay. We have never experienced any difficulty in persuading breeding ewes, which were bought as five-year-olds, to eat hay. The ewes have come from Wanganui, Rangitikei, Manawatu, Wairarapa, Southern Hawke's Bay, Wairoa, Gisborne, and Rotorua and, according to their breeders, have never seen hay in their lives. It is true they eat little for the first two or three days. At the end of the first week they are eating at least a pound and at subsequent shutting-up periods they readily increase their intake to the two pound per day level. Fed in this way, they usually maintain body weight without difficulty. Even in the present season, which has been the most arduous ever experienced, the ewes came through in remarkably fine shape. They were confined for 55 days in all. The longest stretch was one of 29 days and during this 10 in. of rain fell. They were weighed prior to the commencement of control procedures in late January and weighed again a few days after release at the end of April. They had lost under 7 lb. in live-weight in this time, going down from an average of 126½ lb. to 120 lb. A fortnight later they were well over 130 lb. and at present they are being restricted in feed to keep their weight down. It is true that some ewes do not survive a hay feeding treatment. In our view these animals are mostly old ewes already past their prime and would not have long to live in any case.

The second major criticism is that, since facial eczema occurs mainly over the period of tupping, confining ewes to a hay diet reduces lambing percentage very seriously. This has not been our experience. It is true that flushing is not possible. It is true that the number of twins born is smaller but there are compensations. Tupping and subsequent lambing tend to be more concentrated, there is a tendency for fewer dry ewes and, with a lower twinning rate, fewer lambs are lost at lambing. The net result is a lambing percentage not very different from normal since it must surely be agreed that few farmers flush their ewe flocks anyway. The percentage, however, will be lower than in a well-flushed, well-managed flock.

Figures support these views. We have taken out the effective lambing percentage based upon lambs docked to ewes mated of all the Ruakura flocks that have been restricted to a hay diet over the facial eczema years. The figure is 110 per cent. This is actually more than 10 per cent. above the usual figure for fat-lamb farms in the Waikato. Shutting-up is not necessarily a bar to a good lambing percentage.

The third and most serious criticism is that shutting-up does not work. Many farmers have said, "I have followed the Department's advice, shut my sheep up and have still got the disease." We have carefully investigated many such cases and can conscientiously say that the reason has nearly always been obvious, particularly when the farmers have kept diaries of their operations. The advice has not

been properly followed. *The system has failed because the sheep have not been shut up soon enough, tight enough, long enough, or often enough.*

Soon enough means shutting up when the first warm rain falls in an eczema season. It does not mean three or four days later when vigorous re-growth is obvious. It means what it says—as soon as rain falls. For complete safety this is often when rain is actually falling.

Tight enough means at such a high stocking rate that any pasture already on the paddock has disappeared within 12 hours, and no re-growth is observed thereafter. It means several hundred sheep per acre and not a mere 40 or 50. Tight enough also means continuous confinement within stock-proof fences for the whole protective period. It means a hard-hearted farmer for hard-headed reasons.

Long enough means until a definite change in weather and feed actually takes place, plus a few more days for good measure. A soft heart and a soft feed can bring rapid retribution to sheep and bank account.

Often enough means constant watch on weather conditions, the repetition of all precautions each time any risk is likely. Taking a chance, in the later part of the season, can destroy all the good work previously done. Constant vigilance is vital.

* * *

In conclusion, might I say to those optimists who expect from research a cure for the disease or some magical preventive drug or some simple device which will avoid the necessity for them to use their farming skills, that they are very likely to be disappointed. Facial eczema is a nutritional disease. Still worse, it is tied up with environmental conditions over which man has no control. As in many other nutritional diseases of stock—milk fever, grass staggers, sleepy sickness, ketosis, and the like—the skill of the husbandman will always remain a key factor in the protection of his animals.

DISCUSSION

Q:: *Would Dr. McMeekan tell us whether the same control measures apply with calves as wtih sheep?*

DR. MCMEEKAN:: Yes, substitute the words "calf or cow" in the appropriate places in the address and you have my opinion of the situation.

Q:: *I have heard that the pure clover pastures—I believe they have some at Gisborne—have proved to be a means of keeping the lambs growing.*

DR. FILMER:: At Manutuke, and generally speaking in Poverty Bay, and I would think, too, in parts of Hawke's Bay, if the better strains of white clover are sown with short-rotation ryegrass, in a typical hot, dry East Coast summer, the short-rotation ryegrass will disappear completely, and a pure sward of white clover will remain. If that is spelled in the early part of January, one can get a sward of anything from four to eight inches high, depending on the season, which will carry from six to ten, and sometimes as many as twelve hoggets per acre, and do them well. Under those conditions we have never had any trace of liver damage in the hoggets.

I would emphasize, however, that those pastures are almost pure white clover. They are not what some people would term a dominant clover pasture, in which there might be anything up to 40 or 50 per cent. of ryegrass.

Q:: *Do you use crops at Ruakura to protect sheep from eczema?*

DR. MCMEEKAN:: Yes, with emphasis on cropping. Crops will protect dairy cattle from eczema and, in addition, maintain milk yield.

Q:: *There is another aspect of shutting up sheep. We shut up our ewes at the rate of over 200 to the acre. We had them shut up for 18 days. My neighbour shut up 1,050, but he lost five per cent. from* Salmonella. *In the end he decided to let his sheep out as he considered he would lose more from* Salmonella *than he would from facial eczema anyway. I lost one per cent. Could the panel elaborate on this experience?*

DR. FILMER:: That is the sort of thing that can happen. And I must admit that the conditions under which the sheep were shut up at Ruakura are conditions under which *Salmonella* could flourish if it got into a flock. If that does happen, then you are faced with the choice—to have *Salmonella* or facial eczema. I do not know which is the better of these two. If you lost only five per cent. from *Salmonella,* I think you might still be well on the right side.

Q:: *Could you give a definition of* Salmonella?

DR. FILMER:: *Salmonella* is an organism very closely related to the one that causes typhoid in human beings. It causes inflammation of the bowel with which is obtained scouring and quite often sloughing of the lining of the intestine. It is a very unpleasant complaint indeed, and one which is quite difficult to control.

Q:: *Do you suggest that the clover pasture which is allowed to grow long might act as a mulch and so keep the soil temperature down, and that that, in itself, may protect the sheep?*

DR. FILMER:: At the same time as we had the clover shut up we had other paddocks, notably one of short-rotation ryegrass, which we kept growing by irrigation. It was just as long as the clover, and we got facial eczema on that short-rotation ryegrass. So it was not just a question of the soil temperature. We have quite frequently, as I think Dr. McMeekan emphasized, seen facial eczema occur in long pasture. We do not know whether the long pasture itself is toxic, but we do know that eczema can occur in paddocks with long pasture. It may be because the sheep eat out areas and usually concentrate on those shorter areas, but eczema cannot with certainty be prevented by just letting the pasture get a bit longer.

Q:: *The question of when to begin taking precautions is a puzzling one, and some of us are a bit slow, so that it sometimes happens that we wake up one morning and find half our flock infected with facial eczema. The question then is what to do. I have some knowledge of a Chinese herbalist in Auckland, Mr. Salaman Simpson, who states that he carried out some experiments with stock in the Waikato district in the autumn of 1955 and that he cured the sheep. I should like to ask the panel if they knew of those experiments, and if so, what they thought of them?*

DR FILMER:: We are rather glad to be able to deal with this one from a public platform because it has been the subject of a lot of correspondence in the press and to the Minister and so on. Mr. Salaman Simpson issued some printed pamphlets in about August, 1953. In these he made the

claim that he could cure facial eczema, and he offered to bring affected cases to Ruakura at his own expense for a trial. We accepted that offer, the offer is still open, and we are waiting for him to take it up.

Q:: *I believe that at present there are only two scientists at Ruakura working on this problem. Is this correct? The solution of the facial eczema problem has yet to be found and this is a meeting at which we would like, if possible, to influence the Government to make further research possible. I should, therefore, like to ask Dr. Filmer whether he is entirely happy with the labour at his disposal. Is it true that of those two scientists—or, more specifically, chemists—who are supposed to be giving all their time to this problem one had even to go out and cut some of his own grass?*

DR. FILMER:: Let me first of all give you the facts. I have not the exact figures, but over the years I suppose we must have had forty or fifty scientists employed on facial eczema at one time or another. I mentioned earlier that at one time we had ten professional men working full-time just in the field. At that time we had also a number of chemists employed. We have had assistance from several departments. The Department of Scientific and Industrial Research has helped very considerably. We have had assistance from the Meteorological Service, as I told you. It is true that, at present, only two chemists are employed full-time on this job. They have the assistance of nine other men working whole time either assisting them in their chemical research or getting the grass for them or studying the disease in the field. In the address, I tried to explain just how we had planned the research, how we had centralized it around the attempt to discover and identify the liver-damaging factors. The difficulty has not been to get enough men to work on the problem; it has been to get enough material for the men we have to work on it. We have never been limited either for money or for men, and if we need more men or more money I have every hope that the Government will give us what we require. In the past they have done so.

DR. MCMEEKAN:: I should like to add one point to Dr. Filmer's remarks. We were asked if it were true that one of these two chemists had cut his own grass. Yes, it is true. It has been true for a particular reason. I have believed that it does a chemist good to get his nose into the problem in the field. If a chemist merely sits or stands in a laboratory and analyses material provided by somebody else, in my view he isn't as good a chemist as the man who will go out, study the problem in the field, collect his own material and take it back to the laboratory with him. Insofar as my two chemists are concerned, it has been from choice on their part, with very little urging on mine, that they have, last year, operated a grass mower.

Q:: *Members are going to leave the meeting with the impression that you have 300 lb. of poisonous grass—I think Dr. Filmer gave us that figure. Neither Dr. McMeekan nor Dr. Filmer has told us that they are thoroughly satisfied, that they want no further advance or assistance in any way at all, that they have all the men, that they have all the material, and that nothing more can be done. Would they care to give a yes or a no to that?*

DR. FILMER:: I do not know where the speaker got the 300 lb. from. I certainly did not mention such a figure. I could not even tell you how much toxic grass we have at present. I did say that we have only a small quantity, and that I wished we had more. I tried to give you the

reasons why we have not more. We are planning in the future to cut bigger areas and to spread our cutting over more farms, but I also said that one of the chief problems not yet solved is how to preserve that pasture. Unfortunately, if you multiply 0 by 100, you still have 0, and so by spreading collection there is no guarantee that we will greatly increase the amount of toxic grass. We are going to try that out and see if we can get more. I certainly would not say that we are completely happy about everything, as the speaker suggested, and I hope that I never have said that.

Q:: *Would Dr. McMeekan apply the same technique with town-milk cows?*

DR. MCMEEKAN:: Yes, surely, because town-milk cows will produce milk on a crop. If the town-milk supply farmer in an eczema district wants complete protection from eczema, in my view he has only one way of doing it, and that is, he must grow crops for the purpose. They, at least, have the additional advantage of enabling him to guarantee his supply of milk as well.

THE QUESTIONER:: *I am a dairy farmer myself, but I was asking on behalf of a town-milk supply farmer. I had 26 cows with eczema and I dosed them with six ounces of mixed oils, and then turned them straight out on dangerous pasture. They still went on milking, even with the eczema. Most of those cows are now nearly back to normal. Some of them are giving up to 40 lb. of fat about 28 days after treatment. I should like to ask the Department to look into the question of these vegetable oils as a cure for facial eczema.*

DR MCMEEKAN:: Dr. Filmer is better qualified to discuss the question of cures. He did tell you that most sheep will recover from eczema. This observation covers cows. In fact, cows do seem to recover better than sheep. As an example, I can quote a herd in the Waikato which was severely affected with eczema last year. Despite this, no cow was lost and a herd average of over 300 lb. of butterfat was obtained this season under drought conditions. Most cows will continue to produce whether they are dosed with oil, Epsom salts, vinegar, cobalt, copper, or whether no treatment at all is used.

Q:: *Dr. McMeekan mentioned that the aspect of a farm had a bearing on facial eczema—whether it was sunny or whether it was shady. I should like to quote an experience I had 28 years ago. I bought 100 lambs from the high country—2,000 ft. level—and put 50 on to a rich river flat, and more or less a basin, and the other 50 on to shady country on the sodden side of the flat. I lost the whole of the first lot, but did not have one case of eczema on the shady country. That was the first year that there was a veterinarian in the Rangitikei district and he came along, but could not define the trouble. The sheep certainly were jaundiced and suffering from a digestive trouble. The same thing has occurred this year. On the sunny country the sheep developed eczema but on the shady pastures they did not. I suggest that anybody who has shady country can regard it as being pretty safe.*

DR MCMEEKAN:: In my paper I recommended the use of the shady face of a paddock if no alternative method is available. I emphasized, however, that this method is dangerous since eczema can occur in paddocks with a completely southerly aspect. As an example, a Waikato farmer broke down last year after having been most successful in protecting his flocks from eczema by using the techniques recommended. He did so because his ewes were not in particularly good order and he was reluctant to confine

them on hay so that he took a risk with the shady-face method. His flock suffered severe eczema damage.

Q:: *Dr. Filmer said he had records from 1908. Would he say the incidence of facial eczema is on the increase, and is it likely that the risk, without taking the protective measures recommended, is likely to increase more as we improve our pastures?*

DR. FILMER:: The answer to that question can only be an opinion. I arrived in New Zealand in February, 1938, just when the first wave of that year's outbreak occurred. I saw the whole of the second wave in the Waikato which occurred about Good Friday of that year. I have not seen anything since that was as bad as that outbreak in the Waikato, and that is now 18 years ago. The only two years that have in any way approached the severity of that outbreak were the last two. So it is very difficult to say that the severity of the disease is increasing. It is possible that the areas affected have widened, because though it can occur on any kind of pasture it definitely is, on the average, worse on the better pastures. If we get another year such as we had this autumn and we go on improving our pastures as we are, then we could quite well, if we do not take precautions, experience a worse outbreak than we have ever had. On the other hand, on the law of averages, we might easily have four or five years with cool summers in which we get none of the disease at all. I very much doubt if there is any evidence to show that in the last 20 years eczema has become any worse than it was in 1938.

Q:: *In connection with the discussion between Dr. Filmer and Mr. Wheeler, could I bring up the point—seeing that Dr. Mitchell is in the audience—of the controlled climate cabinet. Have they been using this in connection with the grass they are endeavouring to test?*

DR. FILMER:: The idea of producing facial eczema artificially is one that has always been attractive. In 1939 Sir Bruce Levy attempted to grow pasture under glass at Grasslands Division that would be toxic. He also installed electric elements under the soil with a view to increasing ground temperatures in the open. We have attempted, both in the Waikato and at Manutuke, to produce conditions in the summer by irrigating. So far we have always failed. Toxic grass has not been produced under those conditions. If Dr. Mitchell is present, he could tell you exactly what he is doing.

DR. MITCHELL:: Since you are conversant with the work, could I suggest that you report it to members present?

DR. FILMER:: Very well. If I miss any points Dr. Mitchell can pick me up. Dr. Mitchell has a small installation at Grasslands in which he is controlling temperature, light, and soil moisture, and he is attempting by those means to produce toxic grass. He is collaborating very closely with the Ruakura workers, and we will provide him with guinea-pigs for testing the grass that he produces. If he can produce toxic grass under those conditions, or under any other conditions, then nobody will be better pleased than we will because that will be a very big advance in helping us to study the disease. The scarcity of toxic grass has been one of the limiting factors. In spite of the fact that we have just passed through two very bad seasons, the dangerous periods since 1938 do not average more than about one week per year. That is the whole time that we have had in which to collect toxic pasture. So the idea is a very attractive one. Dr. Mitchell is working on it, and I certainly wish him the best of luck.

THE CHAIRMAN:: Perhaps Mr. McFarlane would care to comment. I understand that he has prepared a statement which perhaps he would care to read.

MR. MCFARLANE:: After listening to the speakers I have not a great deal to say. I think it is very difficult for us to be very intelligent about laboratory work. When all is said and done, most of the workers are experts and have been conducting this work for many years. I am rather inclined to go back on a remark of Dr. McMeekan's where he said that it appeared to him that we will inevitably have to live with this disease. I wonder why he did not think of that ten years ago. I am not sure why they did not then begin to study the disease in the field in more detail, and to work on management practices in more detail. Dr. McMeekan says that he has personally investigated quite a large number of claims. But these claims have extended from the Hutt Valley to North Auckland, and even in the short number of years that I have been here the conditions under which facial eczema are carried are very widely diverse. Serious facial eczema has occurred where the grass could not possibly have been collected because it was growing so slowly. It has not occurred where the grass on very warm soils has been growing as fast as it has ever grown. It has occurred on the Gisborne hills—high hills—and unimproved pasture. It has occurred this year where it has never occurred before. I suggest that the poor person who has to advise the farmer might have been in a much better position if the Department had spent more time in investigating the field situation. Control measures are not altogether as simple as Dr. McMeekan points out. In a hill country district there is only a small proportion of the farmers whose sheep get facial eczema in any year when facial eczema is in the district. Is he suggesting that every year when facial eczema might occur every farmer should take facial eczema precautions? The hill country farmer is in a very difficult position. He may have hoggets affected only one year in ten. Does that mean that he should grow crops for ten years just to save his sheep for that one year in ten, or is it more economic for him to adopt a different system of management whereby he can minimize his losses. When the Department says the soil temperatures are up, does that indicate a facial eczema year and does every farmer ever likely to have it go into full facial eczema precautions? I would suggest that that might cost the country more than the disease. I think it is a distinct weakness on the part of the Government Department's research that they have not investigated the conditions under which facial eczema have occurred, and balanced those up so that we, who have to advise the farmers, knew a little bit more about it.

DR. FILMER:: I think Dr. McMeekan hit the nail on the head when he said Mr. McFarlane was not here ten years ago. In my talk I told you that, following the outbreak in 1938, we had ten professional men doing nothing else but studying the field conditions. Since then we have had others. Dr. Cunninghame spent quite a time living on one of the Poverty Bay sheep stations studying the condition in the field. Mr. McFarlane himself, when he was in the Department, spent quite a time going round during facial eczema outbreaks. We have obtained a great deal of data from the field, not only from our straight research people, but from people who live in the field all the time, officers of the Animal Industry Division and of the Extension Division. I believe we must now concentrate on getting a chemical test which will make it worth while making more detailed examination in the field than we have been able to do before. At the same time, I hope we will always have men like Mr. McFarlane in

the field all the time in the Veterinary Clubs, in the Animal Industry Division, in the Extension Division, who can study the field conditions and apply then the principles that we work out in the laboratory. I believe that is the way in which you must organize these things, and I believe that Mr. McFarlane himself is playing quite a large part in doing just that.

Q:: *Is it possible that phenothiazine or some other poison mixes with something in the grass to produce a poison which causes the liver damage?*

DR. FILMER:: The position as I understand it is that this gentleman drenched some of his hoggets with phenothiazine, and he had more facial eczema in those than in the ones which were not drenched. I would think that it was just a coincidence. We have no evidence whatever that phenothiazine has any influence either one way or another on facial eczema. There must surely be people in this audience that have drenched sheep with phenothiazine and not got facial eczema, and have got facial eczema without drenching them. As far as phenothiazine is concerned, you may have seen in the press that there were some deaths in Southland (where, of course, they do not get facial eczema), following drenching during last summer. We followed this up very carefully. We actually got samples of the brand that was used down there and we drenched lambs under identical conditions—or as nearly identical as possible—up to ten times the recommended dose without producing any trouble. I do not pretend to explain the occurrence that has been reported, except to suggest that it was a coincidence. We have no evidence whatever that phenothiazine would influence the incidence of facial eczema one way or another.

THE QUESTIONER:: *May there not be other coincidences that may be worth consideration?*

DR. FILMER:: I do feel that in research you must plan your work and try and obtain some sort of a logical way of approaching a problem. Rightly or wrongly, I have decided that the central point in this is the liver damage and that we must find out just what causes that liver damage. I believe that very strongly, and I believe that when we have got that then we can extend our work quite quickly from that point and answer a number of questions. If, on the other hand, we diffuse our forces following up all the suggestions that are made—and we do receive many, some of them being quite helpful—then I feel that we are not likely to make rapid progress.

Q:: *Are you sure that this toxin in the grass is the cause of the trouble? I differ. What is the toxin you suggest?*

DR. MCMEEKAN:: I am sure. We do not know the precise chemical composition of the toxin but we do know a lot about its chemical properties so that we have been able to eliminate a large number of plant compounds as not being responsible.

THE QUESTIONER:: *I don't think the grass has anything to do with it. More sheep die for want of it.*

DR. MCMEEKAN:: I am sure because I believe in the results of my research staff. I believe their findings, which have been described to you by Dr. Filmer, are sound. Incidentally, these findings are accepted by overseas scientists because they are scientifically based. However, we might still be wrong in the toxin theory but we do not think so. Before long we hope to provide the precise chemical formula of the eczema toxin. Even before this, we hope to have it in a sufficiently pure form to be able to reproduce

the disease by injecting it into a healthy sheep. I believe that we will obtain this purified extract from ryegrass.

A MEMBER:: May I give my experience? In 1938 I had 25 ram hoggets on one dairy farm. I had 20 ram hoggets on another dairy farm. The scabs round the face are caused through rubbing and the 25 were badly affected, and when caught were found to be very thin. On the property where the 20 were grazed there were a lot of pine trees. I used to go up there every day and sometimes twice a day, and the sheep were always crouched under the trees. Not one of them got eczema.

DR. FILMER:: I would like to comment on this. I had hoped I had made the point clear. We have taken grass and fed it to lambs that have never been exposed to facial eczema and we have produced typical liver damage in that way. The chemists have done the same thing in guinea-pigs. They have now got the extract which, as I told you, contains only one four-thousandth of the original grass, and they have produced the typical damage to the liver with that. Now those are facts, gentlemen, they are not theories. And therefore I agree with Dr. McMeekan. I am sure, too, that it is something in the grass that causes the liver damage.

Q:: *This year is the first that facial eczema has appeared on a particular property that I know of. More by good luck than good management, the last 1,200 or 1,300 hoggets were running on a break of choumoellier of about six acres. The head lands were not large and there was no rough feed on the paddock. Eczema broke out in the ewes two or three weeks before it broke out in the hoggets on the crop.*

DR. MCMEEKAN:: When were the hoggets put on the crop?

THE QUESTIONER:: At the beginning of March.

DR. MCMEEKAN:: Field evidence and post mortems indicate that the first wave of toxic grass in the Manawatu this year occurred in late January, immediately after the first rains. I would suggest that the hoggets contracted the disease before they went on to the crop but did not show it clinically until later. As pointed out, a sheep with a damaged liver may show clinical symptoms quite quickly, after an interval which may be up to several months, or it may never show symptoms at all.

DR. FILMER:: I might just follow that up a little and tell you of some of the work which the chemists have done with their guinea-pigs. In one experiment they fed to guinea pigs a toxic sample of grass for seven days. Some of the guinea-pigs were killed at the end of the seven days, and their livers appeared completely healthy. Even with a microscope one could not find anything wrong with them. All the guinea-pigs were, at that time, removed from toxic grass and fed on material which does not cause trouble, and then were killed at intervals up to four, five, or six weeks. The latest ones killed, that were fed for exactly the same time as the first ones on the toxic grass, had very severe liver damage. I do want you to get that point. Liver damage does occur, in some cases, quite slowly and it is quite possible to have lambs that have been on toxic grass, which if killed would show no liver damage. But the process has started, and it will go on developing regardless of what is done to them in the future. It is quite a recognized phenomenon in liver diseases. It happened in a previous investigation when Dr. Gilruth was first investigating ragwort. In his experiments he had some stock feeding on ragwort for a period and nothing happened. He actually terminated the experiment, but fortunately the stock were kept, and they developed trouble some considerable time afterwards. That is a fairly common thing in facial eczema—the damage

goes on progressing after the stock have been removed from the toxic grass. It explains a lot of some of the apparent anomalies that occur in the field.

DR. MCMEEKAN:: With the permission of the chairman, I would like to add to Dr. Filmer's reply to Mr. McFarlane's points and also to comment on the last remark by Mr. Wheeler about getting more chemists on the job. I disagree completely with Mr. McFarlane about the desirability at the present stage of putting a large number of men on to the study of field conditions of facial eczema. I disagree for two reasons. The basic problem is that, by the time the disease appears in any district, it is too late to study field conditions. It is not possible to define accurately the precise combination of environmental conditions by guessing what these were several weeks before. Because of this, the field study of eczema is a most disheartening task to any research officer. Assume that Massey had decided after the 1938 outbreak to put on a team of men to do what Mr. McFarlane has suggested. For 17 years they would have had nothing to do but make observations on climate, pastures, and soils, about a disease that did not turn up. I do not think that even Mr. McFarlane would accept such an assignment. Even in the Waikato, where eczema has occurred five times since 1938, such field officers would have been wasting their time for 13 years. In my experience, no sensible research man will take on such a job. For these reasons, I believe that field work, essential though it is, cannot be advanced until we have developed a chemical test for the presence or absence of the toxin in pasture so that the environmental conditions associated with it can be defined with some accuracy.

Mr. Wheeler is apparently not satisfied yet with Dr. Filmer's reason for my two lonely facial eczema chemists at Ruakura. I wish to add one point on this subject. Some three weeks ago in the presence of Dr. Filmer I asked these chemists whether they could make effective use of more biochemical staff. The answer was "No, not yet. When we get a large quantity of grass of proven toxicity we will need more assistance." From what Dr. Filmer has told you, I am quite certain that when I do ask him for these extra chemists they will be supplied.

MR. WHEELER:: I was merely anxious to see that everything possible that this country can do is done to get to the bottom of this.

Q:: *I come from Taranaki. As far as I am aware there is no one there who has specialized in research on eczema. Is that by design or accident, or is it because there is no one available to do it?*

DR. FILMER:: It is by design. We must concentrate our forces somewhere. At Ruakura, at Manutuke, and previously at Wallaceville, we have the facilities which cost a considerable amount of money, and we can get those together in one or two places. As long as we can get grass for the chemists to work on, it does not matter whether they are in Taranaki or in Ruakura or anywhere else, provided they have the facilities. There is nothing different about facial eczema in Taranaki from facial eczema anywhere else. Once we have got results, we can pass them over to Taranaki —we will do and have done—just as we will to any other place. But I believe it would be quite wasteful and quite inefficient to distribute our research all over the country.

Q:: *Is there anything significant about the incidence of mushrooms and facial eczema?*

DR. FILMER:: As far as I can see, the conditions that produce facial eczema and the conditions that produce mushrooms have a great deal in

common. But I do not think that there is anything more to it than that. In 1938 Mr. J. C. Neill, of the Plant Diseases Division in Auckland, examined fungi in the pastures very thoroughly, and he was unable to find any that we could incriminate in any way. But it is quite true that the conditions that produce mushrooms are very similar to the conditions that produce facial eczema.

Q:: *When were the stock that contracted facial eczema put on the irrigated pastures at Manutuke?*

DR. FILMER:: They were put on at the same time as the lambs were put on to our other experimental pastures. In other words, we put them on every week from the time when we expected the disease to occur following the autumn rains.

Q:: *If you had put them on in December it might have been a different story.*

DR. FILMER:: I do not really know why it would have been. Is the idea that it's the dry feed before that does it, or if not, what is the idea?
THE QUESTIONER:: The idea is that the liver would be better accustomed to that feed, and possibly when the feed became dangerous it would fail to harm the sheep.
DR. FILMER:: At Manutuke the sheep do not come from dry feed. What we do there is to buy our lambs in January before any sign of facial eczema appears. We get the lambs from hill country where eczema does not usually occur anyway. When they are brought to Manutuke they are put straight on to green crops, and they are kept on those green crops until we put them on to the paddocks. I know that there is good field evidence to suggest that what sheep have been fed on before the advent of rain affects the incidence of eczema, and that is something that we have to have a look at. But under these conditions we have produced eczema in lambs that have been on green feed before they were put on to the dangerous feed at the time of the autumn rains. So feeding on green feed during the summer does not necessarily protect against eczema.

Q:: *Would Dr. Filmer define for us, so as to make it quite clear in our minds, what the future local warning procedures will be, so that we know where to look and when to listen?*

DR. FILMER:: I assume they will be the same as they have been in the past. As soon as the temperature records in the summer show that we are experiencing abnormally hot weather, a North Island warning goes out and that is issued to the press, and goes to all country papers. The district warnings are left to the officers of the Department in the particular districts, and when they feel that the critical time is approaching or has arrived, they issue the warning through the press or over the air.

MR. WALSHE:: *On the subject of local warnings, in this district there does appear to be fairly strong evidence that a high grass minimum temperature gives the best warning of impending facial eczema conditions. Would either Dr. Filmer or Dr. McMeekan care to comment on whether that has been confirmed in the Ruakura work? Also, is there any future in individual farmers running their own weather recordings to time their eczema precautions?*

DR. FILMER:: The temperatures that we get from the Weather Office are the average of the maximum and minimum for each fortnight, but in my experience it would not matter much just which temperatures were taken. If there is a real upward trend it will be reflected in most or all of

the temperature measurements. As to whether we would advise farmers to have their own weather recording stations, personally, I think that each farmer would be very well advised to have a rain-gauge. But insofar as temperatures are concerned, individual recordings are not necessary. The Meteorological Office—I am speaking from memory—has 82 recording stations in the North Island at which they record temperatures. I have discussed this quite carefully with them and they have assured me that the heat wave that is likely to produce facial eczema will certainly be reflected in at least some of these weather recording stations. Insofar as temperatures are concerned, I believe you can safely rely on your nearest official weather station. Temperatures do not vary greatly within short distances. Rainfall, on the other hand, can, and it is important, I believe, that you should record your own rainfall on your own property.

MR. WALSHE:: The weather records show that under conditions we understand to be associated with eczema outbreaks, namely rain and cloudy days, atmospheric temperatures can be falling and be relatively low whereas grass minimums can be rising and relatively high. Also I question whether the present meteorological set-up is sufficient. I have seen the microclimate recordings taken around Massey College, where there are three stations within half a mile of each other. The variation between these stations can be considerable.

DR. FILMER:: I think there is just a little confusion here. In issuing the general warning, we are guided by a departure from the average temperature. The original work showed that in every year in which facial eczema had been bad there had been an increase above the average temperature for the particular district concerned. It is surprising how, in those years, there is a widespread upward trend. If you are measuring the exact temperature, quite obviously there will be differences between places. But the important thing seems to be that the temperature is above the average for the particular district, and that is why I believe a farmer might easily get into more bother than enough by relying on temperatures on his own particular farm. The answer that you get depends on how you take the temperature, and it can vary tremendously. Official weather recordings are taken under standard conditions, and as a warning I believe it is that departure from normal that matters so much. The time for taking precautions in those dangerous years depends on the advent of warm rain, and that is something that you must decide for yourself.

DR. MITCHELL:: I have discussed with Mr. Walshe his suggestions. It does appear that there are possibilities in the approach put forward by him that the actual climatic conditions during periods when the feed is considered to be toxic to stock can be more closely defined than has been the case in the past.

Q:: *At Wanganui, where the City Council conducts the weather recording, they have not got the ground temperatures at 4 in. and at 8 in. They have ground temperatures at 1 ft. and 3 ft., which is quite outside the subject we are discussing. So it is quite useless in the Wanganui area to ring the City Council and ask for the ground temperatures.*

DR. FILMER:: Again, examination of the records will show that, where the ground temperatures are up over a period, the atmospheric temperatures are up. Insofar as general warnings are concerned, we have found the departure from normal of the atmospheric temperatures is just as good as any other. When you read the *Proceedings,* you will see that I have given the soil temperature deviations as well as the atmospheric tempera-

ture deviations during those abnormally hot periods (see p. 16), and you will find that they vary in the same direction—not necessarily by the same amount, but in the same direction—and in the years in which bad outbreaks have occurred the atmospheric temperatures during some time in the summer or autumn have always been well above normal.

MR. MCFARLANE:: *I gave what I think most speakers will agree was a simple suggestion. I got two quite distinct answers to it. One question was that we might be in a better position with regard to facial eczema research if there had been more field work done on the job. Dr. Filmer's reply to that was that there were 10 people out in 1938 and quite a lot of work has been done subsequently. I assume, and I think I am correct in assuming, that all that work was done in retrospect, that is, after the outbreak had started. Now Dr. McMeekan stood up and disagreed with me completely because he said that sort of work is no good. It appears that the men on the platform have painted two diametrically opposite things. Dr. Filmer says that because of the work of those people in the field we are now in a position to define the conditions of growth, and Dr. McMeekan stands up and says that that kind of work is no good.*

DR. MCMEEKAN:: I have not contradicted Dr. Filmer at all. What I have said is that I see no point in more field work at the present stage, because such field work cannot define the conditions any better than they have already been defined and I have stressed the weaknesses in this connection. It is true we have a large amount of field information of a general nature. This information I have passed to you. I do not believe, however, that the gaps in our knowledge can be filled by more field work of this type. They will not be filled until we have a chemical test for the presence or absence of the toxin in pasture. With this technique field work will be worth while once more.

Q:: *What weight of toxic grass has to be eaten by a beast before it causes liver damage, and also, is it known whether sheep can eat a certain amount—a small amount—of toxic grass without effect?*

DR. FILMER:: Obviously, until we can determine chemically how much toxin the sheep eats we cannot give any really intelligent answer to that question. It is likely that in some years the sheep develop liver damage quite slowly, and all that you ever see in those sheep is, perhaps, a slackening off in rate of growth, and if they are killed, quite severe liver damage. On other occasions the outbreak can be quite explosive, and a lot of clinical cases occur very quickly. I would suggest that the reasonable explanation is that in the first case sheep eat small amounts of toxin probably over a long period, whereas in the second case they got a large amount over a short period, but that is only conjecture, and must be regarded as such until we can actually measure how much of the actual liver damaging factor is in the grass. At present we can measure the grass, but we cannot measure the concentration of the factor in the grass.

Q:: *You have said that precautions should be taken after the first fall of rain. What is the possibility of trouble occurring after a series of heavy dews?*

DR. MCMEEKAN:: I have followed up many claims that eczema has occurred without rain and that the nearest approach to rain has been a succession of heavy dews. We have always been able to demonstrate that rain actually occurred. Rain sometimes falls at night and is unnoticed. Farmers' memories are sometimes faulty and even day-time showers are forgotten especially when they produce little obvious growth of grass.

I would strongly advise all farmers in eczema-dangerous districts to keep a rain-gauge over the late summer-autumn period.

Q:: *One or two of our rams unfortunately were attacked. Is there any direct relationship between facial eczema and infertility?*

DR. MCMEEKAN:: Rams, particularly Southdowns, seem to very susceptible to facial eczema. I should have emphasized in my address that rams are sheep and, like ewes, should be protected. I have in mind an example of a Waikato farmer who believed sufficiently in our recommendations to protect successfully all his ewes last year but who forgot to take any precautions with his 90 rams. All became clinical cases. Eczema does affect the fertility of a ram. What data we have indicate that the disease does not necessarily render the ram sterile at the time, so that he is capable of leaving lambs if well enough to mate, but that his sexual strength is definitely reduced. Later he may become sterile. We propose to get more information on this question.

Q:: *Are green-feed, oats, barley, or wheat safe crops?*

DR. MCMEEKAN:: We have no evidence on this question. We have not considered it worth while covering the point since green-feed grain crops are hardly practicable at the time of the year when eczema precautions have to be taken.

Q:: *What does toxic grass look like?*

DR. MCMEEKAN:: If I knew, we would not find it so difficult to cut and dry toxic grass for the chemists to work with. The only way we have at present of determining whether or not grass is toxic is to test it by cutting it on chance, drying to preserve the toxin, feeding a sample to a guinea-pig, and examining the liver of the guinea-pig on slaughter. If the liver is damaged, the grass was toxic, but as far as I am concerned it looks just the same as any other grass grown at the same time.

Q:: *Would other conditions predispose a sheep in the direction of having liver damage, such as copper excess in the pasture, and so predispose that sheep for facial eczema?*

DR. FILMER:: Frankly, I have not any information about that. Insofar as an excess of copper is concerned, of course, there is usually a crisis in which the liver copper is released into the blood—the sheep dies and is not likely to show anything further. Whether it would be more susceptible to facial eczema before that crisis I really do not know, but we do get facial eczema in sheep that have had no opportunity of being exposed to other forms of liver toxin.

Q:: *Is it possible for a sheep to have a liver containing six or eight hundred parts of copper per million and show signs of slight jaundice? Could such a sheep be predisposed to facial eczema? I have noticed that in the copper-excess areas eczema seems to be worse—facial eczema seems to kill more there.*

A:: We do not know.

Q:: *Could you tell us whether horses can get eczema?*

DR. FILMER:: I do not know. In 1938 I did see a draught horse in the Waikato with a very prominent blaze that certainly showed photosensitization. I did not have any opportunity of inspecting the liver and that is the only case that I have ever seen.

The JOHN DEERE "GL" GRASSLAND DRILL

The Modern Way to GREENER AND BETTER PASTURES

There is no substitute for good grass. The John Deere "GL" Grassland Drill will enable you to renew your pastures without loss of production. Eliminates ploughing and subsequent erosion.

Outstanding Features Include:

- Hydraulically operated for accurate depth control.
- Notched coulters assist applicators under difficult conditions.
- Permits sowing of manure, grain and seed in one operation at variable depths.
- Variable spacing of coulters to suit any conditions.
- Heavy applicators assist in control of erosion and conservation of moisture.

The John Deere Grassland Drill with safety trip applicators is especially suitable for oversowing marginal land.

Further particulars available from:

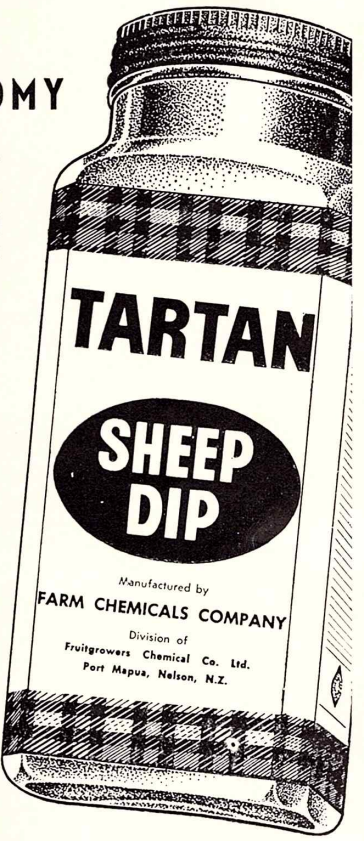
NEW ZEALAND DEALERS

GOUGH, GOUGH & HAMER LTD

145 CASHEL STREET, CHRISTCHURCH
Branches Throughout New Zealand

BETTER CONTROL
with GREATER ECONOMY

TARTAN Sheep Dips give better initial kill of lice, keds and other parasites, greater residual control because of the high concentration of active chemical.



For Fly-strike, Keds and Lice
USE TARTAN ALDRIN or DIELDRIN

For Keds and Lice only
USE TARTAN LINDANE

Available for Bath or Spray Dips

Ultra-fine particles

Because TARTAN Dips are ground to micro-size particles, they give better suspension and dispersion, both in the dip and through the fleece. Stripping and precipitation are reduced to a marked degree and consequently sheep receive a fully effective coverage, giving better kill of parasites and protection against re-infestation.

TARTAN
SHEEP DIPS

Manufactured by FARM CHEMICALS COMPANY
DIVISION OF FRUITGROWERS CHEMICAL CO. LTD.
PORT MAPUA NELSON

DISTRIBUTORS:

North Island: SUMMIT PRODUCTS LTD. Palmerston North.
South Island: A. S. PATERSON & CO. LTD. Blenheim, Christchurch, Dunedin.

G.7314

"CREOTAN"

WOODEN FENCE POSTS

Reg.d Trade Mark

Strong and Durable. 25 per cent Stronger than Totara. Holds Staples Securely Clean to Handle.

Combined CREOSOTE/TANALITH "C" Preservative Treatment provides long life. Immediate delivery ex-stock to any point in the lower half of the North Island. Natural Round Exotic timbers carefully graded for size.

Per 100 posts ex-Works Marton

Type	Top Diameter	Tanalith "C"	"Creotan"
"Air Lift"	3½ in. - 4½ in.	£34 10 0	£37 10 0
"Sheep Yard"	6½ in. - 8½ in.	£39 0 0	£43 0 0
"Standard"	4½ in. - 6½ in.	£43 0 0	£48 0 0

Battens—Sawn—Tanalised. 2 in. x 2 in. x 3 ft. 10 in.: 85/- per 100.

Stays, Strainers, etc., also available.

Enquire from your usual Stock or Station Agent or Timber Merchant for full details and firm prices F.O.R. your nearest N.Z.R. Station or write direct to the producers:

THE MARTON SASH, DOOR & TIMBER CO. LTD.

KENSINGTON ROAD MARTON Phone 2619 P.O. Box 35

NOTE: The creation of fencing materials of high durability from N.Z.'s Exotic Forests, by Pressure Impregnation with proved chemicals is, in its own way, as significant to the farmer as the introduction of fertility to poor soils by artificial fertilisers and trace elements.

BREEDING FOR QUALITY IN PASTURE PLANTS

L. CORKILL*

NO APOLOGIES NEED BE MADE for stating the obvious by saying that New Zealand's welfare is dependent on her grasslands. The more grass we grow, the more milk, meat, and wool we produce, provided the quality of that grass meets the grazing animals' requirements. The breeding of higher producing pasture plants and the distribution of certified seeds of bred strains to the farmer is one facet of grassland research directed towards increasing primary production. It is widely acknowledged that the use of bred strains has contributed in no small measure to this objective. Not only are they more productive than their predecessors but also, because of inherent differences in seasonal production between the strains and species, their use in pasture mixtures enables the farmer to get nearer than formerly in equating pasture production with animal requirements throughout the year.

It is sometimes argued, though, that the pasture-plant breeder has been concerned only with improving quantity, and has forgotten quality. Reference is made to the many metabolic disorders of the grazing animal which are caused by, or said to be caused by, the quality of the herbage from these strains. Facial eczema, bloat, and hogget ill-thrift immediately come to mind. It is asserted that it is the *pedigree* strains of pasture plants which are particularly to blame in causing these disorders. Reliable evidence that this is the case has yet to be produced.

All these troubles were certainly with us before pedigree strains were thought of, and it is difficult to reconcile the relatively limited distribution of certified seeds in the North Island with the widespread distribution of these disorders. There is little direct evidence available, but a trial conducted at Massey College by Clarke, Barton, and Wilson certainly did not incriminate pedigree strains. They made a direct comparison, on the basis of thrift and productivity of ewes and lambs, between pastures sown with certified perennial ryegrass and white clover and those sown with uncertified strains. They found that, although there were differences in annual and seasonal production between the pastures, there was no evidence of any differential effects on the thrift and production of ewes and lambs.

There is plenty of evidence of high per-acre production without abnormally high incidence of metabolic disorders from pastures sown with bred strains. On the Massey College 30 acre dairy farm, on which nothing but certified seed is used, the average per-acre butter-

**Senior Plant Breeder, Grasslands Division, D.S.I.R., Palmerston North.*

fat production for the last four seasons has been well over 300 lb. per season, with no more than average dairy farm losses.

All this evidence shows that the certification tag on a pasture strain does not connote inferior quality as food for the grazing animal. But it is not intended to imply that pasture (whether produced by pedigree or uncertified strains) has not very definite limitations—limitations which may be accentuated by soil, by climate, and by grazing management. The thousands of sheep lost this year from facial eczema are evidence enough for that.

Definition of Pasture Quality

But what contribution can the pasture-plant breeder make towards improving pasture quality? Before this can even be discussed, it is essential to consider what is meant by pasture quality. As representative of the pasture research workers' approach, the definition put forward by Dr. J. Melville at the 1953 meeting of the Animal Production Society could be quoted. His criteria for the ideal pasture were briefly that:

(1) It should be capable of providing the requirements of stock for carbohydrates and protein at high production levels.

(2) It should provide the minerals and accessory food substances essential to animal health in sufficient amount and in a state of balance within the feed.

(3) It should not contain potentially harmful compounds at a level which will cause animal disorders or a decrease in production.

It could be claimed, perhaps, that plant breeders, in selecting for high dry matter production per acre, have concentrated their efforts on the first of the above criteria and neglected the other two. If these factors of quality have been neglected, it is because the fundamental knowledge on which a plant improvement programme could be based is not at present available. We have not gone far enough towards defining precisely just what is meant by quality—what are the chemical compounds in the plant that result in harmful excesses or deficiencies in the diet of the grazing animal. This stage of the approach to the problem is the responsibility of the biochemist, the physiologist, and the nutritionist, as well as the pasture worker. Once the particular aspect of quality is precisely defined, the plant breeder may be able to contribute towards a solution of the problem, if this "quality" characteristic is heritable and if it is not inseparable from the metabolism of the plant.

Current Plant Breeding Work

Let us consider one or two examples of current plant breeding work at the Grasslands Division concerned specifically with pasture quality. The first example is that of cyanide (HCN) in white clover.

HCN in White Clover

In natural strains of white clover occurring in New Zealand, there is a close association between HCN content and agronomic merit—

that is, the merit of the plant as a crop. The vigorous, high-producing, persistent strains are high in HCN and the poor agronomic types are low in HCN. Following the work of Levy and Davies on strain differences, the high-producing high-HCN strains were used as the basis for New Zealand certified white clover. In breeding for increased vigour, it was thought that plants might be selected with a still greater HCN content which could conceivably reach a dangerous level, owing to the well-known toxic properties of cyanide. In other words, white clover might fall into our third criterion of quality—it might contain a potentially harmful compound at a level which would cause animal disorders. Following work on the identification and isolation of the chemical compounds in the plant (cyanogenetic glucoside and enzyme) which determine the production of HCN, and on the inheritance of these compounds, we have been able to breed a white clover strain with the vigorous growth of the certified strain but free from HCN.

As more information on the biochemistry of the clover plant comes to light, so more problems arise for the plant breeder. Recent work by Flux, Butler, Johnson, Glenday, and Petersen has shown that the HCN-producing glucoside of white clover is indirectly a goitrogenic agent (that is, a cause of goitre, which is an enlarged thyroid gland). Cyanide absorbed by the blood is detoxicated by the liver to produce another chemical form, thiocyanate, which inhibits the uptake of iodine by the thyroid gland. It is a deficiency of iodine uptake by the thyroid which leads to the development of a goitre. Fortunately, as Johnson and Butler have shown, the high-glucoside certified strain of white clover is also high in iodine, so that the goitrogenic action of the cyanide is counteracted to some extent. The glucoside-free strain is, on the other hand, very low in iodine. Though it contains no goitrogenic agent, its ability to absorb and accumulate iodine is so low that it may not provide an adequate iodine diet. However, the ability of white clover to absorb iodine appears to be an inherited character not greatly affected by environment. It should therefore be possible, if high iodine and cyanogenetic glucoside are not too closely associated, to breed a strain free from the goitrogenic agent and at the same time high in iodine. Still another problem, however, would then arise in the use of such a strain, for it is known that HCN-free strains are liable to damage by slugs, particularly during establishment.

Palatability

Another factor of pasture quality is the elusive one of palatability. Although there are striking differences in palatability between different pasture species and strains, the real basis for these differences has not been defined.

It is a problem with many intrinsic difficulties, for palatability is affected not only by animal preferences, but also by many environmental factors such as stage of growth, soil fertility, and the relative proportion of the plant in the pasture. Even individual plants show different degrees of palatability at different times. Breeding for improved palatability is therefore not a simple problem. Nevertheless,

TABLE 1: EFFECT OF LEAF RUST ON PALATABILITY OF PERENNIAL RYEGRASS.

Rust Class	Number of Plants	Per cent. of Herbage Eaten
0	26	99
1	109	83
2	174	55
3	247	18
4	119	1

a certain amount of success has been attained in selecting for this quality. The excellent palatability of short-rotation ryegrass is a case in point, where the palatability of Italian ryegrass has been transferred to the Italian perennial hybrid, short-rotation ryegrass.

LEAF RUST AND PALATABILITY

Apart altogether from the inherent palatable or unpalatable nature of the plant, it is known that leaf rust affects the palatability of grasses. This is clearly illustrated by the results of a grazing trial recently carried out at the Grasslands Division.

In this trial a block of 675 spaced perennial ryegrass plants showing differential leaf rust infection were noted on a 0 to 4 scale for intensity of infection. The five classes 0 to 4 indicated: No infection; slight rust; moderate rust; severe rust; and severe rust with the leaves withered. After the amount of herbage on the plants had been estimated by notes on the individual plants, 27 sheep were grazed on the block for five hours. A further productivity estimation was then made, and the amount of herbage eaten was calculated from the difference between the first and second observations. The effect of leaf rust on palatability is shown in Table 1.

Selection for resistance to leaf rust is standard procedure in grass breeding at the Grasslands Division. The degree of success which has attended selection varies between different species. The improvement that has been brought about in short-rotation ryegrass is shown by the relative resistance to rust of the original and latest strains. According to figures supplied by I. Cruickshank of the Plant Diseases Division, the percentage of plants completely resistant to leaf rust has been built up from 9 per cent. in the original strain to 75 per cent. in the latest strain of short-rotation ryegrass.

Plant Breeding and the Facial Eczema Problem

Cases of improvement in quality of pasture plants where the particular feature of quality has been defined and a basis for selection established have been quoted above. It may be of interest to conjecture what part plant breeding may be able to play in the attack on the problem of facial eczema. Dr. J. Filmer has reported (see p. 11) on the results to date of the research on the causal factor which is being investigated at the Animal Research Station at Ruakura.

To be able to assess the possibilities of a successful plant breeding approach there are many questions to be answered. Can the presence of the toxic material be readily determined in individual plants? Tests would have to be made on many plants. It is known that environmental factors markedly influence the amount of the material in the plant. This difficulty need not, however, be insuperable, for selection could possibly be carried out under a controlled environment set-up. Are there inherited differences between plants of the one species in their potential content of the toxic material? Unless such differences occur, selection will be ineffective. If the answers to these questions are in the affirmative, a plant breeding approach to the problem would probably be warranted.

We should be realistic in regard to the practical significance of a non-toxic ryegrass strain, should it be possible to breed one. The problem certainly would not be immediately solved. It would take many years before such a strain could be produced and tested and a seed supply distributed. It should be remembered, too, that in the North Island a very small proportion of pastures is replaced annually, so unless there was a change to a widespread plough-up policy it would take a considerable time before a significant proportion of pastures was sown with a "safe" strain. The effect of such a policy would be minimized too if grasses other than ryegrasses can also be dangerous.

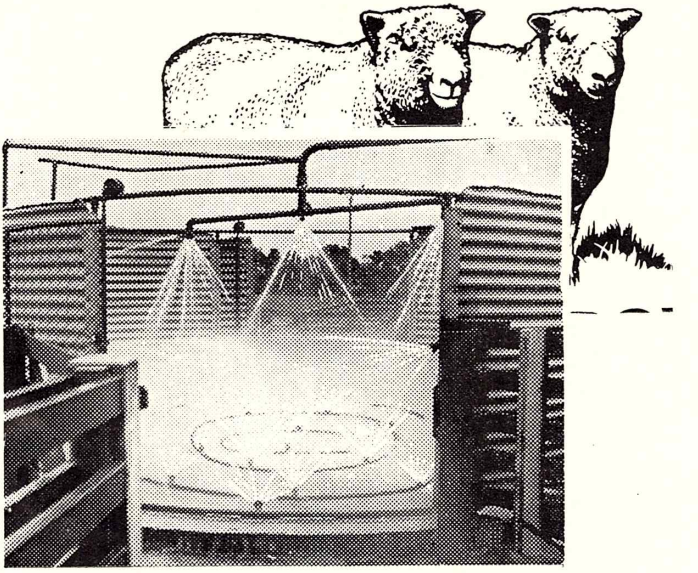
In his paper (see p. 21), Dr. C. P. McMeekan has stated that the farmer has in his own hands methods of stock and grazing control to escape eczema. As long ago as 1942 methods for escaping the disease by pasture and stock management practices were recommended by Levy and Smallfield, and since then the Department of Agriculture has issued warnings and advice to farmers each summer. The loss of stock from the disease this year would seem to indicate either that the method of control is not effective, or that it is not being correctly or fully applied. The latter is to be suspected and, if so, would the necessary re-orientation of grassland farming management with a vigorous pasture replacement policy be adopted, if a 'safe" strain of ryegrass were available? Only the farmer can supply the answer. However, it would not be necessary to replace all ryegrass pastures with a "safe" strain. If only a proportion were replaced, these could be reserved for grazing during periods when trouble might be expected.

* * *

In conclusion, it should be reiterated that the plant breeder is fully alive to his responsibilities to breed for quality in pasture plants. The progress that can be made is very largely dependent upon the provision of fundamental information on the basis of pasture plant quality—information which the plant breeder hopes will eventually be forthcoming by collaboration with the biochemist, the physiologist, and the nutritionist.

Oh Boy! This sure is dipping with a difference!—No crowding . . . no getting knocked about!"

"I could feel that dip soaking through and through . . . yet I could readily breathe!"



INSTALL A

'BUZACOTT'

ROTATING POWER-SPRAY DIP

Acclaimed by every user in Australia and New Zealand—AVAILABLE NOW for prompt delivery. You save ALL ways with the "Buzacott" . . . keeps dip strained and clean so that it goes further . . . is more effective! Gives equal distribution. Does not knock the sheep about. Wets EVERY sheep thoroughly. Breathing gap protects EVERY sheep!

Enquire NOW at all branches of . . .

Dalgety

AND COMPANY LIMITED

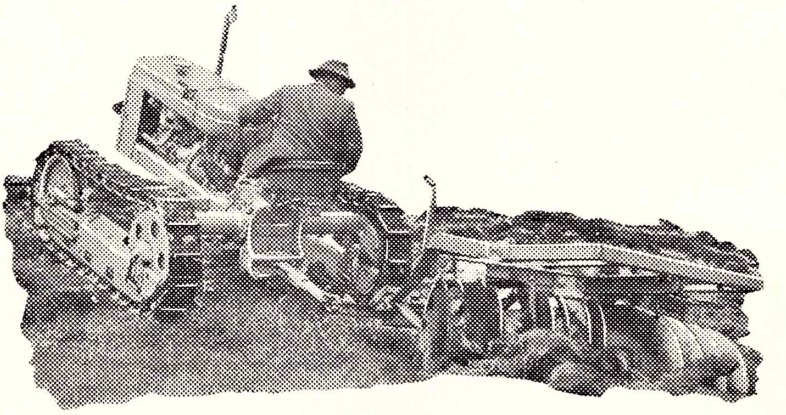
(Incorporated in England)

The All Purpose . . .

All Weather . . .

OLIVER MODEL 'OC-3'

CRAWLER TRACTOR



Tested by Nebraska at 22 Drawbar H.P., the Oliver "OC-3" developes a greater drawbar pull at working speeds than many tractors of larger advertised horsepower. Thus it can do many jobs normally handled by only a big tractor. Then, of course, its size and manoeuvrability permit it to work tight places and steep hillsides where the big tractors could not operate.

DISTRIBUTED THROUGHOUT N.Z. BY

FREDERIC W. SMITH LTD.

P.O. BOX 1623 WELLINGTON

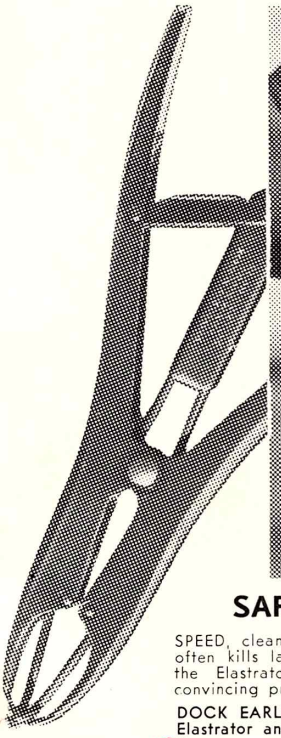
THERE IS AN OLIVER DEALER IN YOUR DISTRICT

throughout New Zealand and Australia

on all counts

PROVED SUCCESSFUL

for castrating lambs.



SAFE BLOODLESS HUMANE

SPEED, cleanliness, absence of blood, elimination of shock (that so often kills lambs when castrated with the knife) and the fact that the Elastrator can be used in any kind of weather, are the convincing proofs that recommend it to practical men.

DOCK EARLY—For the small flock the ideal way is to daily carry Elastrator and rings and dock lambs in the paddock as they come. The younger the lambs the better and safer the operation. Any time from birth to about three weeks is ideal.

The Super Elastrator & RINGS

Order from your Stock Agent or direct from Elastrator Co. Ltd., Box 226, Blenheim. Write too, for full descriptive leaflets.

CASTRATOR AND TAILER

PROVISION OF ALTERNATIVE FEED WHEN PASTURES ARE DANGEROUS

SILAGE AND HAY: HARVESTING AND STORAGE IN RELATION TO QUALITY ..... *R. H. Schwass* 57

MACHINERY FOR SILAGE AND HAYMAKING ..... *M. W. Cross* 63

LATE SUMMER AND AUTUMN FODDER CROPS ..... *G. S. Robinson* 71

IMPROVED CROP YIELDS BY MORE EFFICIENT USE OF MACHINERY ..... *M. W. Cross* 76

PLANNING FOR ALTERNATIVE FEEDS TO PASTURE ..... *N. Watson* 85

MODIFICATIONS TO PRESENT-DAY TILLAGE PRACTICES ..... *M. W. Cross* 96

What's in a name..?

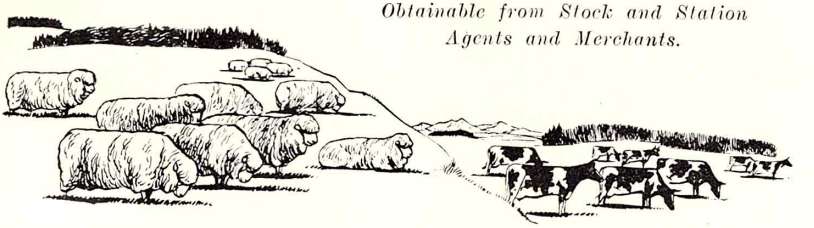
The Cooper name on a Stock Remedy is your assurance of high quality and complete dependability.

For well over one hundred years Cooper Products have set the standard all over the world and Cooper Scientists are ceaselessly engaged on research in the interests of the man on the land.

YOU CAN DEPEND ON

COOPER PRODUCTS

Obtainable from Stock and Station Agents and Merchants.



COOPER, McDOUGALL & ROBERTSON (N.Z.) LTD.

BOX 599, AUCKLAND

SILAGE AND HAY

HARVESTING AND STORAGE IN RELATION TO QUALITY

R. H. SCHWASS*

OVER THE LAST EIGHT SEASONS, pasture cut annually for hay in New Zealand has averaged some 540,000 acres. In the latest season for which detailed figures are available, 1953-54, 69 per cent. of the hay area was saved in the North Island. The South Auckland land district harvested 31 per cent.; North Auckland 13 per cent.; and Taranaki and Wellington, each 10 per cent. Canterbury harvested 14 per cent. of the total.

The area of pasture cut for silage over the same eight-year period has shown well-marked trends. It increased from about 47,000 acres in 1947-48 to a maximum of nearly 213,000 acres in 1952-53, mainly because of the availability of new mechanical aids to harvesting, but has since declined to some 144,000 acres. During 1953-54, 92½ per cent. of this silage was made in the North Island. Of this, 58 per cent. was made in the South Auckland land district, 14 per cent. in Taranaki, and 12½ per cent. in North Auckland.

Lucerne cut for hay or silage has been round the 90,000 acre mark for the last three years, and over 80 per cent. of it is cut in the South Island. In the North Island, South Auckland and Hawke's Bay have relatively small acreages.

These figures indicate that pasture conservation is of far greater importance in the dairying districts. The best information on the place of these fodders in farming types comes from the recently published final report on the agricultural census taken in the 1949-50 season. Dairy farms in New Zealand saved 96 per cent. of the silage and 75 per cent. of the hay. Sheep farms accounted for 3 per cent. of the silage and 19 per cent. of the hay. There is plenty of scope on sheep farms in all districts for making these products from surplus pasture growth in the spring.

Silage as a Feed

There is a widespread belief that sheep will not eat silage, or if they do they will not maintain condition since silage is supposed to have a poor nutritive value. These ideas are largely misconceptions because there is evidence of successful silage feeding to sheep.

Articles in the *N.Z. Journal of Agriculture* for April and October, 1930, describe the experiences of more than 25 sheepfarmers scattered over much of the country. The ration fed was generally small, about

**Senior Lecturer in Field Husbandry, Massey Agricultural College, Palmerston North.*

2 lb. of silage per head per day used as a supplement to grass and in some cases to turnips. The feeding rate could be stepped up to 5 lb. daily where silage was the sole or major item in the diet. There seemed to be general agreement among these farmers that silage was readily eaten by sheep once they had acquired a taste for it but that a period of up to a fortnight might be occupied in getting the flock to take it. Animals should be in good condition before feeding starts since it may be necessary to starve them on to silage. The best method was to concentrate the stock in a bare paddock and offer them no alternative to the silage until they were eating it freely. The use of a few sheep which had previously become accustomed to silage as decoys could reduce the period involved.

More recently, the Christchurch *Press* for September 8, 1951, reported the successful experiences of five farmers in Canterbury in feeding silage to sheep. In one case, the grass used was toppings from a perennial ryegrass seed crop prior to closing.

Silage is also recommended for sheep feeding in some overseas countries, notably France, United Kingdom, and South Africa. Recent Scottish experiments repeated for three years have shown that silage made from leafy pasture can serve as the basis of a ration for wintering half-bred ewes, and can replace both hay and roots for this purpose. These trials involved feeding 8 lb. of silage before lambing and 12 lb. afterwards, supplemented in each case by ½ lb. of concentrates. Incidentally, silage digestibility trials in many countries have used sheep as the test animals, and live-weight is regularly maintained or even increased.

In all these cases, silage was fed to sheep for wintering. We are interested in the feeding of silage at a time when pastures have become dangerous, but stock should be on an adequate nutritional level because of the imminence of tupping. This means, of course, that silage used for this purpose must be of good quality. To understand the recommendations for the making of good quality silage, it is necessary to have some appreciation of the processes which occur during harvest and storage.

Processes of Silage Making

After cutting, plant cells continue to respire until the oxygen which is trapped between leaves during filling is used. Heat is developed in the mass of herbage, and the best silage is produced when the temperature rises to some 100 to 110°F. At lower temperatures, certain bacteria can set up undesirable fermentations leading to sour silage and the formation of volatile acids, like butyric with its offensive odour. At higher temperatures, there is excessive loss of carbohydrate from the plant tissues, as well as changes in the digestibility of protein. In both cases, the silage loses much of its palatability—an important point with sheep. At the desired temperature, bacterial action leads to the formation of lactic acid, and after several days the level of acidity is high enough to stop further

bacterial activity and to preserve the silage. Thus good silage will result when the rapid build-up of lactic acid has been the dominant process during fermentation.

Pasture is by no means an ideal medium for this activity. Lactic acid formation is favoured by high carbohydrate levels, but young grass and clover is relatively rich in protein. Pasture is at its most satisfactory stage just as the main grasses are coming into flowerhead. The protein content is still high but the carbohydrates have increased in this maturer herbage. By cutting the pasture fairly high, it is possible to avoid the inclusion of much of the coarse and stemmy tissue at the base of the plants, and to speed up the recovery growth in the aftermath.

Methods of harvest greatly influence the losses of nutrients. If young material is ensiled too fast, much butyric acid will be formed in the low temperature and water-logged conditions. On the other hand, if drainage is too free, up to 15 per cent. of the dry matter can be lost in the exudate. Such material can well be wilted for several hours after cutting to bring it into better condition. If mature material is ensiled too slowly, the excessive heating will lead to comparable losses.

The correct rate at which the pasture should be harvested is largely a matter of experience, and depends upon the condition of the pasture and the method being used. With the popular buckrake, consolidation in the trench or wedge is greater than that obtained by lifting grass on to stacks. Filling should therefore be slower so that adequate heating takes place before the material is firmly packed down. To avoid loss of time, two trenches or wedges can be filled at the same time. In all cases, heating should be allowed to build-up in the lowest layers before more material is ensiled, or sour silage will develop in the bottom.

New Methods of Storage of Silage

The use of modern harvesting equipment has led to several new methods of storage. Trenches dug in suitable ground with proper drainage and good winter access are excellent. The material can be packed tightly throughout the trench, and, with a correct batter, spoilage should be negligible at the sides. Their major disadvantage is their fixed position, so that, to avoid long hauls, nearby paddocks are cut very frequently and others are never saved for silage. Semi-permanent walled clamps built from wooden posts and case timber above ground have the same advantages as trenches and are reasonably portable. Pits filled properly have little wastage, but tractors cannot be used for consolidation until near the end of filling. Wedges suffer from the problem of getting efficient packing right out to the edges, and this is largely overcome with a well-sited bun or inverted saucer where the tractor can approach and leave from any direction. With all methods, a seal over the top reduces wastage by several inches. The familiar earth seal is now being replaced by one made of young grass growth packed down hard immediately after cutting.

Some experimental work has been done on the use of nitrogenous fertilizers for silage and hay, and the following comments can be made through the courtesy of the Department of Agriculture. One hundredweight per acre is more economic than two hundredweight per acre, and the lighter dressing has not caused any marked clover suppression. Rates heavier than one hundredweight have this suppressing effect. The fertilizer should be applied to good ryegrass pastures during the early spring. August-September, and increases in pasture growth of up to 500 lb. dry matter per acre can be expected in silage crops. Since responses decline later in the season, much smaller increases would be found with hay. Overseas work suggests that nitrogen applications about ten days before cutting increase the protein content of the grass, but this has not been studied in New Zealand. In any case, the protein content in leafy herbage is quite adequate.

Improving Fermentation Conditions

Many attempts have been made to improve fermentation conditions in silage. Equipment which chops or lacerates the leaves after cutting exposes the contents of plant cells more rapidly to bacterial action, and can speed up the formation of lactic acid. Various chemical additives have been used. In Finland, the A.I.V. process using mineral acids was developed, but it is not suitable for New Zealand conditions on the score of the cost of the acids, the equipment needed and the unpleasantness of handling. Molasses, a simple form of carbohydrate, has been added to provide bacteria with a more suitable growth medium, though there is no clear-cut evidence in this country of much beneficial effect.

More recently, sodium metabisulphite has been used in the United States and tried in New Zealand during the past two seasons. Bisulphite appears to inhibit much of the protein breakdown and the production of butyric acid, while allowing some lactic acid fermentation to take place. The reduced bacterial activity lowers nutrient losses, and this feature has shown up in local studies, to the extent of some 10 to 15 per cent. An unsolved problem is to apply the bisulphite at 8 to 10 lb. per ton of herbage so that even and intimate mixing is obtained. The present conclusion is that bisulphite has little effect on silage made from over-mature herbage, but can improve silage made from young pasture—that is, bisulphite can be useful in getting quality.

The cost of these additives may be of interest. The current local price of Australian molasses is £7 10s. 0d. per 44 gal. drum. At the rate of approximately 30 lb. per ton of herbage, which may be on the light side, this would treat some 15 tons of green material, or about 10s. per ton. New Zealand molasses, when available, is £5 10s. 0d. per drum, but is much thinner.

Bisulphite is sold at 10½d. per lb., so the treatment costs some 7s. to 9s. per ton of herbage.

With an average crop of, say, 6 to 8 tons green weight per acre, the cost in either case would be between £2 and £4 per acre; this would not be economic unless a substantial improvement in quality resulted.

Hay

Now for hay. Quality in this fodder depends in the first instance upon the herbage used. The younger the pasture when cut, the higher is the protein content, the lower is the yield per acre, and the greater is the difficulty encountered in drying it. Good hay can be made from leafy pasture with a reasonable clover content, and cut as the main grasses are coming into flowerhead. The higher yield obtained by waiting a week or so before cutting after this stage has been reached is accompanied by a rapid decline in protein. Clover is desirable because of the nutrient quality of the leaves themselves and because of their fertility building effect which should be apparent in vigorous grass growth. This can be assisted by a phosphate top-dressing when the pasture is closed. Paddocks saved several years in succession for hay usually have weak clover and the grasses are unthrifty. The coarse growth which is so common in these cases can make only an unpalatable hay. Here again the crop can be cut high to reduce the amount of stem in the hay and to speed up the recovery growth.

Given good material, quality now depends on the drying process. This involves the reduction of the moisture content from some 75 per cent. in freshly-cut herbage to about 25 per cent. or less, at which level hay can be stored without over-heating or becoming mouldy. This drying should be rapid and preferably by the action of wind blowing through the loosened swath. Sun dries hay unevenly, and the top layers may start to shed leaves on handling while the bottom layers are still damp. Sun drying also results in much loss of carotene and hence of vitamin A, although this loss can also be due to over-mature herbage and to fermentation of damp hay in the bale or stack. Hay which is over-dry will shatter on handling and much leaf is lost in this way. Rain on a dry hay crop is very damaging, causing the breaking of leaves and the dissolving out of the more soluble and digestible nutrients.

Haymaking Weather

Since the drying of hay is so dependent on weather conditions, farmers are advised to make use of the forecasting service of the Meteorological Service. Forecasts in New Zealand for periods of more than 48 hours from the time of issue are possible only occasionally, while forecasts for more than four days ahead are not attempted. While the degree of uncertainty in such a long-range forecast is naturally greater than in tomorrow's forecast, there are certain weather situations when a forecast can be made with reasonable confidence up to four days ahead.

The use of this service appears to be increasing. Between January, 1954, and December, 1955, more than 200 farmers obtained one

or more haymaking forecasts, while the number of new names on the list in December, 1954, was 29, and in December, 1955, was 48. Requests can be made by letter to the Director, N.Z. Meteorological Service, Box 722, Wellington, or by telegram to "Weather, Wellington." Replies are sent by "collect" telegram—the Service does not appreciate "reply paid" telegrams because of their restriction on the length of the reply, and the complication in the handling of vouchers when replies may be delayed for several days. The request should state the type of weather and the nature of the job—fair weather for haymaking or cold spells during shearing—the dates between which the forecast is required, and the farm's exact location and altitude if this is not clear from the name of the telegraph office.

The use of the newer implements has simplified haymaking. The tedder, aerator, swath-turner, stem crusher and pick-up baler should all help to make good hay the rule rather than the exception, but their use in a contractor's hands means that many a farmer will have his hay harvested when it is not ready or is over-mature. The answer is the private ownership of the gear, and this will not be economic unless large areas are saved each season.

Once hay is made, it must be protected from the weather. Stacks need careful thatching and should be well raked down so that rain is turned out and does not penetrate into the stack. Bales should be stored in Dutch barns if available, or else covered with tarpaulins or thatched with straw. If the bales are a little damp, they should be stooked before storage, and stacked so that air can freely circulate between them. To assist in this drying, especially since the tendency is to bale rather too early, bale density should not be greater than about 10 lb. per cubic foot.

Any farmer can adopt improved practices, and so ensure that his hay and silage are of better quality than before. The use of good pasture cut at the correct stage of growth, the provision of suitable fermentation conditions in the case of silage, and the efficient drying of hay crops, will all help to produce feedstuffs which may have some value in the autumn when pasture itself can present problems in utilization.

MACHINERY FOR SILAGE AND HAY-MAKING

M. W. CROSS*

THERE ARE TODAY MANY VERY EXCELLENT MACHINES designed to perform a wide variety of tasks on the farm. When they were designed and the prototypes built, but before mass production commenced, they had to demonstrate that they could perform their respective tasks to the satisfaction of, not only the engineers who built them, but also hard-headed business men who had to sell them and agriculturists who had to use them.

This point should be remembered when next a machine is condemned because of inferior performances. Very frequently the fault lies with the operator. He may not be using the most suitable machine for the particular work or condition. He may not understand the machine sufficiently to enable him to operate it correctly. He may have neglected to maintain it in serviceable condition by failing to replace worn parts or carrying out periodic adjustments.

In the previous paper, Mr. Schwass has discussed the factors involved in producing good quality silage and hay. To follow out his recommendations, whatever machinery is chosen must be operated correctly—successful harvesting depends ultimately upon the operator.

Before deciding upon the system (and machinery) to use for silage making, the merits of each method should be carefully considered; buckrake or sweep, green-crop loader, forage-harvester or front-end loader. At the same time, the other end of the scale is important—can any of this equipment help with feeding-out?

Types of Machinery Available

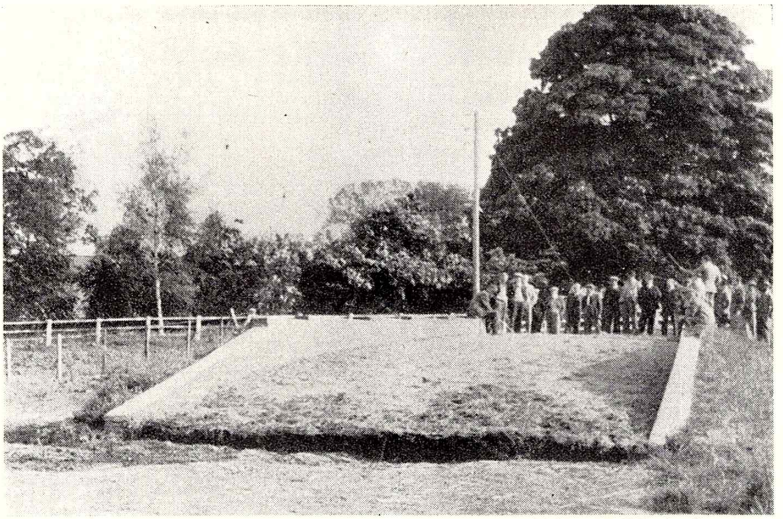
It is not possible here to discuss each system fully, but a few comments on each can be made.

BUCKRAKE

The buckrake has literally "swept the country." To dairy farmers it has provided a cheap and efficient method which allows one man to put in about 20 acres of silage by himself between milkings. This will be spread over about 4 to 6 weeks. With an assistant the acreage can be increased or the time lessened. One man constantly at the pit allows the buckrake to be kept moving, and speed is the essence of success.

An extra minute should not be spent in the field trying to pick up a really big load—dash off with what has been collected. Top gear must be used for all travelling; this is possible only if paddock surfaces are smooth.

**Senior Lecturer in Field Husbandry, Massey Agricultural College, Palmerston North.*



[photo.: W. A. Jacques.

A partially filled walled clamp suitable for buckrake operation on areas too flat for trenches. Portable sides may be used instead of the permanent concrete sides shown. With metalled access and a firm bottom these walled clamps are being used for self-feeding the silage to dairy cattle. By the use of these clamps for buckrake silage the safety factor is increased and consolidation is possible right out to the edges.

The buckrake's performance drops off rapidly if hauls are more than ¼ mile; therefore the clamp, wedge, bun, etc., should be situated in the same field. This can be a disadvantage. A permanent centrally-situated silo allows greater flexibility in the choice of pastures to be cut; feeding-out is simplified, particularly in winter, as permanent roading and drainage can be provided, and less damage to pastures will result.

If conditions are suited to buckrake operation, this is without doubt the speediest and cheapest method of ensiling. A small labour force only is required—two or three buckrakes can be used if tractors and operators are available. The capital outlay is still small. Ample consolidation can be provided by the tractor during filling, and, by dumping the loads correctly, hand spreading can be reduced to a minimum. During the year additional uses for the buckrake, including feeding-out, can be found on most farms.

Sweeps attached to the front of tractors are sometimes used but they have little to commend them when compared with the buckrake. If the farm tractor has no hydraulic lift, a sweep is both cheap and useful if there is a pit in the same field. In a few instances it may also be used for haymaking.

Green-crop Loader

The green-crop loader is really a mobile elevator which, when attached behind a lorry or trailer, loads the mower-swath on to the

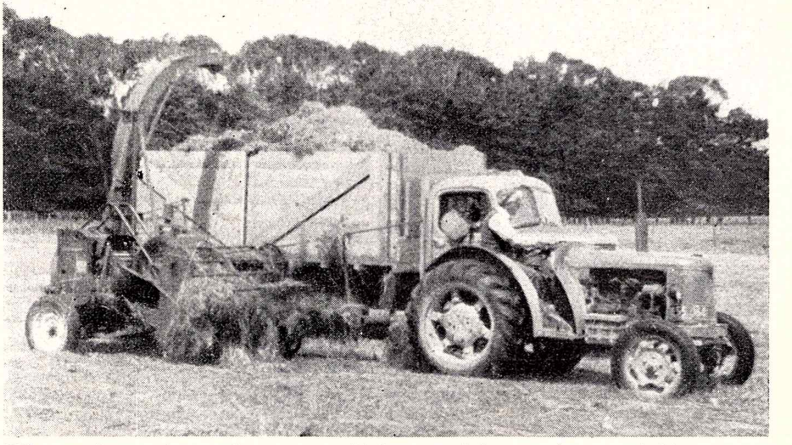
deck. It is a suitable machine for use with a centrally-situated silo or where long hauls are involved, but a fair amount of hard manual labour is required.

FORAGE HARVESTERS

A recent addition to the medium-output field of forage harvesters is the Silorator-Hayter harvester. Basically, this is a very simple machine, consisting of approximately 75 parts. The revolving-knife is a most effective cutting principle in all types of going. Criticisms that it does not cut low enough are not valid. In any event, grass stalks are not wanted for silage and a quicker regrowth of the pasture results from a longer stubble.

The large fan draws the cut material from the cutting discs, lacerates it, then blows it into a towed trailer. There are no complicated feeds, no chopping knives to sharpen or replace, and the sometimes objectionable noise has been considerably muffled by fitting a silencer. Priced at about £450 and operated by one man, it provides a most efficient and labour-saving silage harvesting device. It can also be used for pasture topping and possibly for haymaking.

On the debit side, it requires a tractor of at least 30 b.h.p. if an output of round 10 tons per hour is to be maintained; the cutting tips (four mower sections to each disc) are readily shorn off by stones; and an extra cost for high-sided trailers is unavoidable. During operation blockages occur readily if the operator allows his attention to wander, but with correct manipulation its performance is most satisfactory.



When using a forage-harvester which can pick up, chop, and blow green material into the truck at the rate of 20 tons per hour, first-class organization is essential to obviate waiting time in the field. It is only by detailed planning for the uninterrupted disposal of the chopped grass that an expensive machine, such as this, can be made an economic return for the initial investment.

The effect of laceration is claimed to improve quality, reduce losses, and allow quicker ensiling because of more rapid heating. Trials in Germany substantiate this claim and New Zealand farmers have been agreeably surprised at the ease with which the silage can be dug out of the pit.

A new silage harvester of about the same capacity has made its debut in Australia. This comprises a high-sided trailer, on the front of which is mounted a simple cutting and blowing mechanism. In operation the hammer-knife, which is P.T.O.-driven, literally whips off the grass and blows it into the trailer. When loaded, the P.T.O. is disengaged and the whole unit towed to the silo. If a self-unloading device is fitted, this combination should be the centre of much attention from those interested in a one man silage-harvesting machine.

When a large tonnage and long hauls are involved, high-output forage harvesters priced from £1,000 upwards are available. Those more commonly known can chop and load from the windrow or swath up to about 20 tons per hour, but machines with capacities of about 40 tons per hour are available.

If such costly equipment is used, efficient organization is of paramount importance—there must be no idle time. As a result, at least 2 trucks, or 2 trailers and a tractor, are necessary for haulage. A crew of 3 or 4 can maintain an output of about 15 tons per hour if sufficient attention has been paid to the design and sighting of the trenches. At Massey two trucks are used for cartage, and trenches of about 120 tons capacity have been found the most suitable.

Front-end Loaders

The tractor front-end loader is popular with many farmers. Where the contour suits its operation it offers a most attractive proposition requiring only 2 men, neither of whom do much heavy manual labour. There is one type which costs about £500 complete with all attachments. With a silage sweep fitted, the cut grass can be picked from the swath, pushed to a stack or pit in the same field where it can be placed exactly where required. Collecting rate is equal to, or better than, the buckrake, because larger loads are possible.

By fitting a bucket, the pit or stack when finished may be covered with earth. (In the first place the pit can be dug by the same bucket or blade.)

For feeding-out, a grab can be fitted and the silage lifted out on to a trailer. For haymaking, a push-off sweep will build round stacks up to 25 ft., and requires only 2 men, neither of whom are overworked. Again, when feeding-out the grab does all the hard work.

Feeding Out

Feeding-out is probably the most unpleasant task associated with silage making, but even this job can be completely mechanized. A

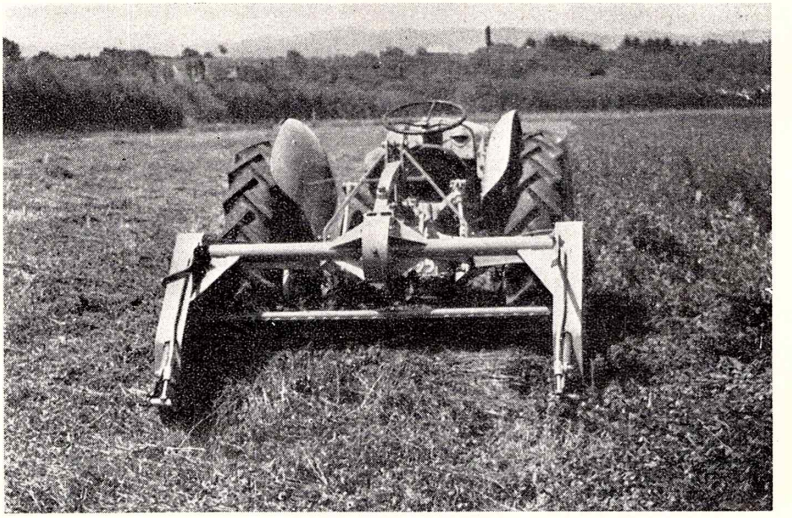
farmyard-manure distributor has been modified to increase its usefulness on the farm. When fitted with high sides and with the beaters removed, it is used to collect chopped grass from a forage harvester. Its capacity is about 3 tons. At the pit or trench the moving floor, driven from the tractor's P.T.O., discharges the load where required. For feeding-out, one beater and a deflector are fitted at the rear. The distributor is loaded by a tractor-mounted silage grab, and in the field the load is discharged by the moving floor, spread by the single beater, caught by the deflector and deposited in a neat windrow across the field. This system, or modifications of it, could well be adopted where the tonnage involved was sufficient to warrant the cost.

Advances in Haymaking Machinery

Improvements in haymaking machinery, although not so spectacular as with silage equipment, have nonetheless been steadily produced.

Mowers still use the conventional type cutter-bar, but working speeds have been stepped-up to about 10 m.p.h. And, if the going is good, why not?

The mid-mounted mower is to be preferred because it is easier on the operator. The cutter-bar is always under the eye and when cutting close to fences or obstacles it responds immediately (and in the same



This particular "hay crusher" is mounted on the tractor's hydraulic lift and is used in conjunction with a side-mounted mower. It picks up and crushes the mower swath cut on the previous round. It is most suitable for lucerne or other thicker-stemmed crops and in good weather reduces drying time by almost half. No benefit is derived from its use under poor drying conditions.

direction) to movement of the front wheels. But one should ensure that the mower can be effortlessly and quickly attached or removed by one man.

To make first quality hay it should be windrowed immediately after cutting and the windrows turned daily. An efficient and speedy side delivery rake is therefore required. Of those available, the finger wheel rake appears to be the most desirable. It is fast, efficient, relatively cheap, has a very low maintenance cost, and can be used for turning or collecting. One combination consists of a front-mounted finger wheel rake collecting two swaths into one windrow which is then immediately picked up by a baler towed by the same tractor.

In the more humid areas—*e.g.*, North Auckland—a tedder is probably necessary, but in drier areas a side rake which can be used for swath turning is sufficient.

The widespread use of the baler has resulted because of the convenience of handling the packaged hay. But the best hay is still probably made in stacks, and reference should be made to the tractor-mounted push-off sweep-loader mentioned on p. 66.

The round bale is commended for its ability to shed water—thus there is not the same urgency to collect and store them when baling is completed.

A newcomer, the low-density baler, may possibly allow hay, of a higher moisture content than could be baled with the conventional baler, to be safely packaged and stored. The loosely-packed bales, which weigh about 30 to 40 lb., do not shed rain, require almost double the storage space, and break up easily during handling.

The place of the "hay crusher" or "conditioner" appears to be on properties making lucerne hay. Its use facilitates drying when conditions are good, thus more hay can be made in a given time. If conditions are wet or humid, however, the hay is all the more readily spoiled.

Whether hay or silage is being made, the machinery used must be thoroughly understood, adjusted, and maintained in accordance with the maker's recommendations, and above all, must be operated intelligently having due regard to the prevailing conditions. Only by so doing can the machine reproduce in the field the effect intended by its designers.

DISCUSSION

THE CHAIRMAN:: *I should like to ask Mr. Cross if he can give us some information on the costs of haymaking and silage making using the modern machines that he has been discussing. I appreciate that this is a pretty wide question, but after hearing Mr. Cross speaking about the various machines I would be glad if he could express a few views on costs per ton.*

MR. CROSS:: I am sorry, but I should not like to answer that on the spot. Cost per ton is something very intangible, especially with hay.

The situation differs so much on each individual farm. The operators differ in their attitude to hard work; the machinery that each farmer chooses differs. Two farmers with identical farms, identical conditions and machinery, will vary greatly in their output. As an example, a detailed survey of methods and performances when feeding out silage showed a variation of from 31 man-minutes per ton to 120 man-minutes per ton. Costs per bale or per ton would vary in consequence.

Costs of some of the machines have been mentioned, and they are all fairly high. Buckrakes are about £60; green-crop loaders about £100; the Silorator forage harvester about £450. Forage harvesters with large capacities are over £1,000, and if a machine about this price is chosen it must have a good output, otherwise it is a doubtful proposition.

With regard to haymaking equipment, one comment I should like to make on price is that the finger-wheel rake is very desirable because of its simplicity, and it should be one of the cheapest. It should be possible to buy it for less than £100, though it remains to be seen whether import of this piece of machinery will be allowed. The price of the New Zealand-made tractor-drawn side rake and tedder combination—*i.e.*, a side delivery rake which can be worked in reverse gear, equipped for tractor operation—is, from memory, about £140 or £160, and maintenance costs are higher than for the finger-wheel rake. American-made machines will be somewhere over £200. Whether their cost is justified I would not like to say—many farmers have their own definite opinions. I feel that farmers do not want to saddle themselves with very expensive single-purpose machinery. If a large sum is being paid out for a machine, it must be able to do more than one specific job. It has to be a versatile machine. That is why I am so particularly attracted by the front-end loader system. It is suitable for silage, suitable for hay, suitable for a hundred-and-one jobs round the farm during the year, and suitable for feeding out. This particular one cost about £500 complete with six attachments. All the attachments are easily put on to the machine, merely by pushing in two or three bolts and securing them with lynch pins. Nothing could be simpler. There is no hard work attached to it. That, I feel, is the way we want to go. We do not want to do unnecessarily hard work; we want to get the results, and we want to get them cheaply.

Q:: *Have any studies been made on the use of the hay baler for silage making?*

MR. CROSS:: Not at Massey. We have had a number of reports from places where trials have been undertaken, which can be summed up very briefly. If there is a baler already on the farm, it is probably satisfactory to use it for silage making, provided the farmer is willing to carry the bales from the field to the pit and manhandle them into position in the pit and then manhandle them out again when feeding-out time comes. It is very heavy work. In England and Scotland, comparative trials have been carried out, and it has been found that the cost of making silage by using a baler is more expensive than if a buckrake is used. The difference in cost is quite considerable. Where, however, a machine has another cost against it, that is, if it is on the farm already and it is being used for both hay and silage, and if there is some means of handling the bales—they are fairly heavy, being from about 70 to 80 lb. each, although they are only half the size of hay bales—then it would be quite economic. Personally, I would not like to use it, because of the hard work involved.

Q:: *What about the use of plastic covers for silage?*

MR. SCHWASS:: These are good if they are economic. The covering of the silage is most important, particularly where bisulphite is being used. With bisulphite, sulphur dioxide gas is released, and if that escapes to the air, then the process can lose quite a lot of its efficiency; hence the point I made of the necessity for a seal.

Q:: *Does the use of young grass as a seal on a wedge or bun retain its effectiveness after, say, a year?*

MR. SCHWASS:: We have no clear-cut evidence on that point, but it is doubtful whether it would be as effective after, say, a year's storage, as a well-made earth seal. Certainly over a short period it would be effective, but it is likely that weathering could influence the seal and tend to break it down over a period of several months. This would depend, to some extent, on the amount of grass that was used in the sealing layer, and the firmness with which it was packed.

Q:: *Would surplus autumn pasture be suitable for making silage?*

MR SCHWASS:: Yes. Provided the stage of growth of the pasture is satisfactory silage could well be made from autumn pasture. In the silage-making processes, of course, there is a loss of possibly 40 to 50 per cent. of the pasture dry matter, so that silage is normally made from spring grass, when there is a genuine surplus of pasture. Whether you can justify making silage from autumn grass, when there is possibly not a true surplus, is another matter.

Q:: *What would be the cost of an efficient pick-up baler?*

MR. CROSS:: It varies greatly. A power take-off driven model will be about £750. An engine-functioned one, with a capacity of six bales a minute, would cost probably £1,500. There is a big variation in the cost. If you are buying an engine-functioned one, you also have to pay for the motor, which may be lying idle for the rest of the year, and, of course, the high capacity. A string tie is slightly cheaper than a wire tie.

Q:: *What would you consider to be the minimum tonnage of hay to justify the cost of such an implement?*

MR. CROSS:: If you were making approximately 3,000 to 3,500 bales a year (say, 100 tons), then you would be able to recoup the cost of a £1,000 machine in possibly five years. If you engaged a contractor, that is roughly what it would cost for baling. I should think under those conditions its purchase would be warranted, particularly if some baling for neighbours can be worked in as well—and this is frequently possible.

Q:: *Would the air spaces between silage bales in storage tend to lead to poor fermentation conditions in the making of silage?*

MR. SCHWASS:: That is certainly a factor which needs to be considered. It could be overcome by packing loose material tightly between the bales. In the first place, of course, bales should be packed as evenly as possible to reduce the air spaces between them, and then the tractor can be used for consolidation. Done properly, even density over the whole set-up should be obtained, but this can involve quite a lot of laborious work in manhandling the bales into the pit and in stacking them correctly and tightly.

LATE SUMMER AND AUTUMN FODDER CROPS

G. S. ROBINSON*

DESPITE THE BETTER EQUIPMENT which is now available for seed-bed preparation and sowing, there are still far too many failures amongst forage crops. The cause of these failures is sometimes difficult to pin-point, but, when once realized, can usually be remedied without undue cost or effort.

Let us consider, then, what a crop plant requires during its growing period and how the conditions provided for it measure up to these requirements.

Moisture Requirements

Many paddocks cultivated for crops suffer from an over-supply of moisture in the spring. Where the water-table is close to the surface or where storm water is unable to get away quickly, the crop seedlings are quite incapable of making strong root growth—an essential requirement for their rapid early development. It is not impossible for a well-drained seed-bed to go hand in hand with a ready supply of moisture. Roots are just as dependent for their growth on the oxygen of the air (which can percolate into such soils) as are the leaves above the ground or, for that matter, as we are for our existence. Drainage of wet soils should preferably be done before the land is ploughed, and, on land that is otherwise of good fertility, there is no reason why a satisfactory crop should not be obtained in the following season.

Although the soil in the spring is sometimes damp right to the surface, seed lying there often does not receive enough moisture to germinate quickly. A crop plant in this position is then at the mercy of weed seedlings whose roots are well placed to gain ample moisture. The method of sowing, therefore, should aim at burying the seed at a depth dependent on its size, but at least into soil that is damp. An expensive drill may not be necessary. Sowing on the corrugations left by a Cambridge roller is satisfactory for small seeds and ensures that most of the seed is covered. With cereals and other large seeded crops, drilling is more effective. Apart from moisture considerations, bird damage is reduced to a minimum when seed is placed in the soil. Broadcasting followed by discing often buries seed too deep.

Satisfying the moisture requirements of the young plants does not reduce the plants' need for moisture at later stages. Deficiencies may be due to several causes, all of which can generally be traced back to inefficient cultivation.

In the first place, the seed-bed should be ready for sowing early enough in the season to give a sufficiently long growing period on light soils before the dry period sets in. Then, as far as the quality of the seed-bed is concerned, the soil should be well consolidated to ensure continuity of supply of moisture and to give the growing

**Senior Lecturer in Field Husbandry, Massey Agricultural College.*

crop a firm hold in the soil. This is all the more necessary on light soils which do not pack down naturally through the effect of rain. Efficiency of cultivation can nearly always be judged by the firmness of the seed-bed. Where the country is too steep to roll, a fallow period after the initial discing or ploughing will help consolidation, mainly by giving time for the turf to decay. Later cultivation should not loosen up the seed-bed too deeply.

The more a soil is cultivated deeply, the more it will dry out. Soil moisture vaporizes freely under these conditions and evaporates. When this happens late in the season and where sowing has been delayed for one reason or another, moisture can become a limiting factor to good crop growth. Care must therefore be taken in the later stages of cultivation that only the surface is loosened up.

On the other hand, if the initial ploughing has been badly done, it is very difficult to make amends in the later working up of the seed-bed. There are two conditions that are frequently met with. The first occurs when a paddock is being ploughed out of grass. It should be eaten down hard so that there is no impervious layer of undecayed foggage to interrupt the passage of moisture between the furrow slice and the subsoil. Secondly, a sod-bound pasture when ploughed is inclined to result in a series of ribbons of turf on which it is most difficult to produce an even seed-bed. Unless the furrows are turned over very flat, air pockets cannot be eliminated. When crop roots reach these air pockets, growth is slowed up. Such paddocks are best dealt with by wintering the stock there, and feeding out hay and silage. If this does not break the turf, then discing a week or two before ploughing will be helpful; or even better, a light cut with a rotary cultivator will make certain that there is no bridging of the furrows in the later ploughing. From the point of view of moisture control and tilth, a very efficient job can be done with a rotary cultivator alone, but several cultivations will be necessary.

The Importance of Soil Fertility

The term "soil fertility" embraces many factors, but satisfactory soil fertility generally implies an adequate supply of the main minerals in a form available to plants. Lime, phosphate, and potash are commonly deficient in our soils, and soil testing indicates how these deficiencies can be overcome. Crops are just as sensitive in their requirements as is pasture. In fact, a shortage of some of the minor nutrients shows up more clearly in crops—*e.g.*, boron deficiency causing brown heart in swedes and mangolds. The point is, however, that we know or can find out what deficiencies are present in our soils and can economically overcome them by suitable fertilizer dressings.

Where crops are being drilled, this fertilizer should be sown with the seed as it speeds up establishment. But only insoluble material should be used for this purpose otherwise germination injury can follow.

Nitrogen has not been mentioned so far, although it is just as

important as phosphate in limiting crop yields. It must, however, be considered separately because clovers are largely responsible for increasing the available nitrogen in our soils, or, in other words, the organic matter content. In fact, we have come to regard a high fertility soil primarily as one that is amply supplied with nitrogen. This normally occurs where a pasture containing plenty of clover has been growing for some years. Nearly all our forage crops require for maximum growth a ready and ample supply of nitrogen. The more they can be given the better they will yield. Very rarely is a good crop seen in a paddock that has carried a low-producing pasture. The cropping programme should therefore be planned some years ahead, so that poor pastures can be improved by topdressing, overdrilling, or feeding out to bring them to a level of fertility capable of producing a worthwhile crop.

Some boost to natural supplies of nitrogen can be given by using artificial forms, but the effectiveness of this will be less on soils of high fertility. R. du Faur of the Franklin Farm Improvement Club obtained an increase of 7 tons per acre from 1 cwt. of nitrogen on soft turnips grown on a range of soil fertility levels. With choumoellier, 1 cwt. of nitrogenous fertilizer gave him an increased yield of 6¼ tons and 2 cwt. an increase of 11 tons per acre. At Massey College this year, on a paddock of very high fertility, 2 cwt. gave an increase of only 3 tons, and 4 cwt. gave an increase of 4½ tons per acre.

The Weed Question

Weed competition is another factor that limits high yields of autumn forage crops. Where we have had trouble with weeds at Massey College we have grown successful crops by sowing in rows about 2 ft. apart. This allows for at least one early cultivation between the rows and gives the crop a better chance to compete. Increases in yield of choumoellier of up to 30 per cent. have been obtained. There is still some trouble with weeds *in* the rows, but there is a good chance that a weed killer such as Oktone may prove useful in controlling them. An experiment where several row spacings were tried on land free of weeds has just been completed. The results showed that the heaviest crops were grown where the spacings were closest. There appears, therefore, to be no advantage in sowing in wide rows on clean land.

Other points in regard to weed control are:

(1) There is no advantage in inter-row cultivation apart from weed control.

(2) Second year cropping of the one paddock increases weed infestation.

(3) Ploughing will normally produce a cleaner seed-bed than will rotary cultivation on its own.

Seed Rates

Shortage of seed of choumoellier has focused attention on seeding rates. Results from trials at Massey over a number of years indicate that total yield is only slightly influenced by seed rates ranging from

1 lb. to 6 lb. per acre. Some increase in stemminess results from light seed rates; this would be greater in crops not used until late autumn.

Machines which would space the seed of root crops like swedes and turnips more evenly in the soil would enable better crops to be grown. Seed rate, of course, will depend on germination percentage, which should always be determined.

Crops for Autumn Use

Crops that can be used in the summer and late autumn can be divided into the following three classes:

(1) Crops that are fully grown or nearly so at this time of the year, such as soft turnips, choumoellier, rape, green maize, millet, lupins, Hungry-gap kale and field cabbage.

(2) Crops grown normally for winter use but which can be used in autumn if necessary—*e.g.*, swedes, thousand-headed kale, fodder beet.

(3) Catch crops such as the cereal green-feeds—*e.g.*, oats, barley, ryecorn.

These can be considered separately. Soft turnips are a quick-growing crop and over most of the North Island should be sown for use some three to four months after the sowing date. In this way the maximum yield will be obtained without loss from overmaturity and rotting. They are not good keepers when sown for summer use and can be of greatest value for the early part of the dry spell. Their keeping quality improves when sown about New Year for winter feed, but their yield is reduced. New Zealand York Globe is the best variety for this latter purpose. For summer use, the Purple, Red and Green Globe varieties are all satisfactory. They can be sown as soon as a good seed-bed can be prepared in the spring.

Choumoellier is a far more versatile crop. It will not grow quite as quickly as soft turnips in the early stages, but from three months onwards it continues to add to its store of edible material till well on in the autumn. The proportion of leaf to stem decreases as the crop matures, most of the increase in yield occurring in the stem which, however, gets progressively more fibrous.

Choumoellier requires a soil well supplied with organic matter and responds to the practice of feeding out supplementary feed during the winter months before ploughing. Heavier soils are required than for soft turnips if the crop is to make progress during the dry summer. The seed should not be sown before the soil becomes friable in the spring. Wet, cold conditions immediately after sowing will rot much of the seed. If the crop is sown in wide drills, we have found at Massey that at least one cultivation as soon as the seedlings appear in the rows is necessary to check weed growth and allow the choumoellier plants to overshadow the next batch of weed seedlings that germinate. A second cultivation is usually advisable. If growing conditions are good, a worthwhile yield can be obtained as early as January from a late September sowing—this year, we harvested a 45 tons per acre crop some 16 weeks after sowing.

Of the remaining crops in this group, rape is not very satisfactory when the time that it is required is not definitely known as it deteriorates with keeping. Hungry-gap kale is in a somewhat similar position. Green maize is not normally a sheep feed, but, apart from the wastage that would occur in feeding off, there is no reason why it could not be used by sheep, and it is a heavy yielder in warm districts. Japanese millet is not being recommended as an alternative source of feed because there have been cases reported by Dr. J. Filmer of photosensitivity in sheep fed on millet. Lupins are not easy to grow satisfactorily. They require feeding at a definite stage of growth and are expensive.

Of the crops normally grown for winter feeding, thousand-headed kale sown in October will be worth feeding in the autumn if necessary. At this time of the year, however, it is often very unpalatable. Early sown swedes should be well advanced by autumn, but are more commonly grown in cooler districts where eczema is not so troublesome. Fodder beet is a relatively new crop to this country. It should be grown on fertile land and is not greatly affected by dry summers. Unlike mangolds, beet can be used at any stage of growth, both tops and roots being most palatable and nutritious. Unfortunately, the crop has to be hand thinned and although it is a heavy yielder it is expensive to grow.

The cereal green-feed crops must be considered as catch crops, yielding comparatively little in a dry autumn because, if they are sown early—before Christmas—they tend to run to seed, while, if sown late, the soil is too dry (in a dry period) to allow them to make much growth until the autumn rains come. January sowings can sometimes be successful if the land has been fallowed from late spring, while in a wet summer there is, of course, no difficulty. Other points are:

(1) Ryecorn is the least likely to run to seed if sown early; the N.I.A.B. variety should be used.

(2) Barley will produce the quickest grazing crop.

(3) Oats are more valuable when they can be left till winter before being grazed. Algerians should be used for this purpose.

Summarizing:

(1) An optimum supply of soil moisture to the growing crop can be best helped by: (a) Good drainage. (b) Placement of the seed in the soil. (c) A well-firmed seed-bed.

(2) Soil mineral deficiencies should be avoided by using suitable fertilizers. The better the pasture ploughed, the less is nitrogen likely to limit crop yields.

(3) Control of weed competition is essential to successful cropping.

(4) The crop chosen will depend on the climatic conditions of the district, but the most promising general-purpose crop for use from summer on to winter is choumoellier.

IMPROVED CROP YIELDS BY MORE EFFICIENT USE OF MACHINERY

M. W. CROSS*

CROP PRODUCTION BEGINS WITH THE preparation of the soil to receive the seed. Although methods of cultivation will vary with localities, basic principles remain unaltered. During the process of producing a satisfactory tilth, the greatest possible weed kill should be achieved. To ensure this, cultivations should be spaced sufficiently to allow a germination of weed seeds near the surface between each trip over the field. As sowing time approaches, so should the depth of cultivation be reduced to avoid bringing more seeds to the surface and allowing them to germinate with the crop.

Preparation of the Soil

It is recommended that the initial ploughing be done early—during or before winter for preference—but this is not always practicable. In such circumstances, it is all the more desirable to surface-cultivate the closely-grazed grassland before ploughing. The same applies when turning under a green-crop. Especially if the ploughing is late there is a tendency if the land is not surface-cultivated to turn under a mat which, in a dry season, can have drastic results by effectively insulating the subsoil from the top soil, which then rapidly dries out. Discs, cultivators, or a rotary hoe working about 2 in. to 3 in. deep are equally satisfactory, although with the first two implements at least two trips over the field are required.

If the turf is broken *before* ploughing, the reduction in the number of cultivations necessary *after* ploughing, as well as the improvement in the seed-bed, will more than offset the cost of this operation.

Unfortunately, many farmers, and machinery salesmen too, do not appreciate the value of the skim coulter on the plough but reject it as an added complication. This attachment, now standard equipment on a great many ploughs, does an excellent job of ensuring a complete burial of surface vegetation. On either grass or arable land, it pares off the top left-hand edge of the furrow and turns this into the bottom. When the furrows are turned over, no vegetation whatsoever protrudes at the join between them. Moreover, it is much easier to consolidate such furrows and so eliminate the air space underneath.

By cultivating and breaking the turf before ploughing, the plough mouldboards can effect a greater degree of pulverization on the furrow slice, thus saving later workings. In this regard, the use of semi-digger mouldboards is strongly recommended. It is significant that the World Ploughing Match Committee should confine this event to the type of mouldboard most suited to general-purpose tractor

**Senior Lecturer in Field Husbandry, Massey Agricultural College, Palmerston North.*

ploughing—the semi-digger. And competitors are required to plough uncultivated grassland as well as stubble.

The use of the rotary cultivator in preference to ploughing is mentioned on many occasions. On the lighter soils or in drier areas, it is being used most successfully. There are a number of features in favour of its use for areas of cropping such as are being discussed here, but it must be used correctly.

Under ideal conditions, the first cut on grassland should be no more than 3 in. deep and the forward speed should be as fast as the tractor can comfortably handle the load. The field should then be left for at least a fortnight, during which the grass either dies or commences to re-establish. Weed seeds near the surface will also germinate.

The second cut is done at the desired full depth of working. This time forward speed will be slower and the soil well pulverized. Many operators, however, tend to travel too slowly and so produce an unnecessarily fine tilth. Tine harrowing should follow at intervals. This provides consolidation below the surface and kills germinated weeds. A rolling to complete top consolidation prior to sowing is almost invariably essential. The major practical drawbacks to the rotary cultivator are its cost (both initial and operating) and wet weather. In the wetter districts in particular, serious consideration indeed must be given before complete dependence upon this method of cultivation is entertained.

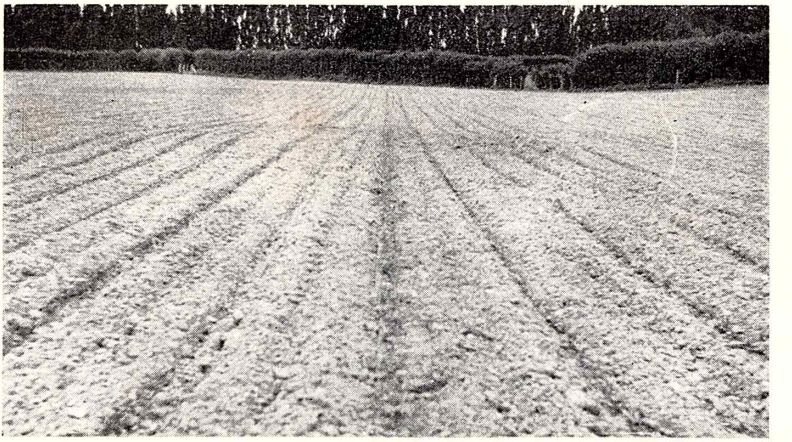
If giant discs are employed in preference to the rotary cultivator, the same principles should be observed in allowing a germination of weeds between treatments. Of course, more tilth producing cultivations will be required and these will be spread over a much longer period.

Methods of Seed Sowing

A number of factors should govern the choice of equipment for sowing the seed. On reasonably weed-free soils the preference for broadcasting, or sowing the crop in narrow rows, has been mentioned in the previous paper (see p. 71). The advantages of this method, in terms of crop yield, will be nullified unless an even distribution of the seed over the field is achieved. The aim should be to obtain a complete coverage of the field by the crop leaves in the shortest possible time. Not only has each plant the maximum room for development but the resultant shading will inhibit weed growth. Coupled with this is efficient prior cultivation which will reduce the weed population at or near the surface.

Mixing the seed with fertilizer and broadcasting through a top-dresser is, at the best, a haphazard means of obtaining an even distribution. It is done, and in many cases with reasonably good results, but these could be significantly improved—and methods of achieving the best results are under discussion here.

The distribution obtained from seeders spaced about 7 in. apart is infinitely superior. The first logical improvement would be to attach



This crop of choumoellier has been sown in 24 in. rows and has just been intercultivated for the first time. Note the way the disc weeder has moved the soil away from the crop; next intercultivation this will be returned around the plants.

a seed box, with the appropriate seeders, to the topdresser—a connection to the topdresser drive is easily arranged. The seed, however, will still be broadcast on the surface and many seedlings will fail to survive.

If a drill is available, it is obviously a much better choice, but to purchase one for this specific purpose is out of the question because of cost unless large acreages or other types of cropping are involved. An effective solution appears to be the "V-type" or "deep-flange" roller-drill.

As at present available, the roller rings are 20 in. in diameter and have a V-shaped profile instead of the scalloped Cambridge pattern. To this roller is fitted a fertilizer box and a seed box, both placed so that the seed and fertilizer fall together *behind* the roller. A light chain harrow completes the combine.

In operation, the V-type rings consolidate and groove the soil. Seed and fertilizer fall together to the bottom of the grooves and are positively covered with no more than an inch of soil by the chain harrow. The seed thus sown comes up in 3 in. rows, has the benefit of the concentration of fertilizer, is uniformly distributed, and is placed in the best possible position for the germination and establishment of each seed. Added to this, the operations of rolling, sowing fertilizer, sowing seed, and covering are done in one trip over the field and no time is taken up with mixing the seed and fertilizer. This combination is also very suitable for sowing down pastures, and the roller by itself for normal cultivation.

The last operation immediately prior to sowing seed with the roller-drill should be a tine harrowing. This will dislodge and kill

The same crop of choumoellier as in the preceding illustration 16 weeks later when it yielded 45 tons per acre. It received two intercultivations, spaced correctly, and these were sufficient to control weed growth until the crop completely shaded the ground. At the time of harvesting, only a few straggly weeds were present in the rows, although without cultivation weeds would probably have taken control.

any weed seedlings, break up any dry surface layer, and leave a loose surface which is consolidated and grooved by the V-type rings. In common with other methods of sowing, the greater the attention to smoothing or levelling the field, the better will be the results. As with the Cambridge roller, the V-roller should not be used on wet or sticky soils, and in districts of high rainfall other methods of sowing should be employed. But on any light or gravelly soils or in drier districts this method can be thoroughly recommended.

On weedy ground, the seed should be sown in rows sufficiently wide to permit later inter-cultivation. On areas of up to 2 or 3 acres, this can be done quite effectively with the hand-operated Planet Junior equipment. For larger areas, a seed and fertilizer drill adjusted to sow through every 3rd or 4th coulter, or the roller-drill similarly adjusted, is required. The width between the rows needs to be approximately double the width of the rear tyres of the tractor to be used for inter-cultivation.

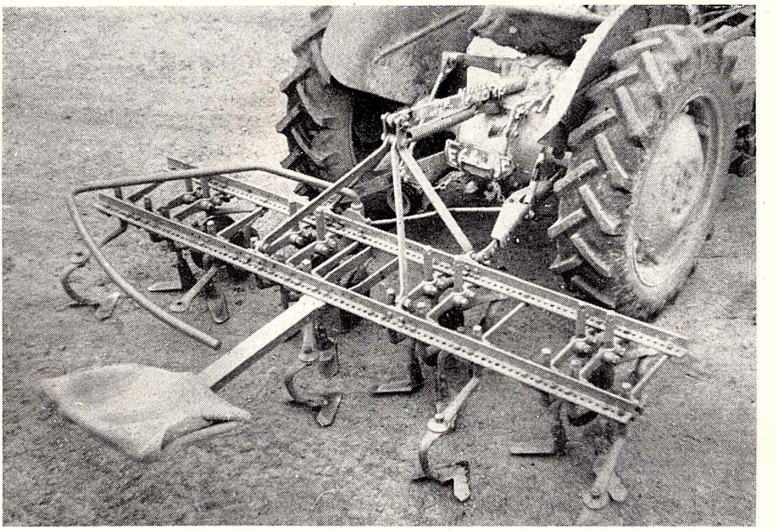
With such sowings, the fertilizer is concentrated along each row and therefore heavy dressings of soluble fertilizers should be avoided or germination injury will occur.

Intercultivation

Among many North Island farmers, the very word "intercultivation" engenders a singular lack of enthusiasm. Yet this operation can be very straightforward, requiring no special skill or technical efficiency and the minimum of specialized equipment. In return, it may make the difference between a good crop and practically none at all.

With a quick growing crop like choumoellier, especially on fertile soil, two intercultivations correctly spaced will usually suffice to control weeds between the rows. The first should be done as soon as possible after the rows become discernible; the second approximately three weeks later, or at the latest date that the tractor wheels can travel along the rows without damaging plant leaves. As has been stated elsewhere (see p. 71), intercultivations in excess of those required for weed control can depress yields.

The most satisfactory equipment for work close to the plants is a rear-mounted tool-bar which is steered by a second operator. This may not be popular with many sheep farmers but it is mentioned because I consider it to be the ideal. The steerage hoe used at Massey cultivates four 2 ft. rows at a time (matching the drill) and is fitted with a pair of disc weeders, a pair of right-and-left hoes and one 10 in. duckfoot sweep per row. For the first cultivation, the disc weeders are set at an angle so that they throw a shallow skimming of soil



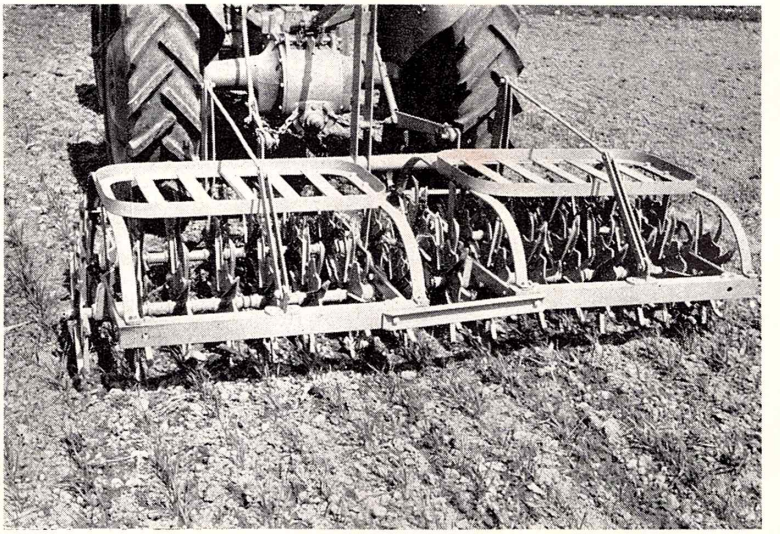
The steerage hoe used for intercultivation. The disc weeders are set to cut closest to the seedling crop and very accurate work is possible as the hoes are steered by the second operator. (Set to cultivate four 24 in. rows.)

away from the seedlings. The leading edges of the discs cut up to about 1 in. from the plants on either side and the soil is displaced sideways about 3 in. On the Massey implement, the right-and-left hoes and the duckfoot sweep are used to cultivate the remainder of the gap. One duckfoot sweep of sufficient width could well do this work.

At the second cultivation, the discs cut about 5 to 6 in. away from the plants on either side but are angled this time so that they throw the soil around the plants, thus smothering a number of weeds along the rows. This moulding-up is, if anything, beneficial to the crop. Again the duckfoot sweeps cultivate the remaining ground.

In the absence of this type of tool-bar, reasonably efficient work can be done with a rear-mounted cultivator, the tines of which have been adjusted to match the rows. A stabilizing fin to prevent undue side-swing is essential if work close to the plants is to be attempted. However, the use of disc weeders close to the plants would again be recommended as they have not the same tendency to block or to disrupt the soil around the plants as have the right-and-left hand knife weeders.

Whatever type of cultivator is used, it must be adjusted to match the rows, *in the field*. And when cultivating, travel should be in the same direction as the crop was drilled and the same number of rows cultivated. Observance of these points eliminates the risk of error and the consequent destruction of crop plants as well as weeds.



The rotary weeder is used extensively in America for intercultivating maize up to about 6 in. high. When used on choumoellier it caused surprisingly little damage to the crop yet appreciably reduced the weeds. Suitable only in dry areas.

Smaller areas of crop—up to, say, 5 acres—can be cultivated with the hand-operated Planet Junior hoes. Although a seemingly retrograde step (from the mechanical viewpoint), cultivation with these hoes can be started when the plants are no more than 1 in. high and can be done when the ground is too wet for tractor work.

The rotary weeder was tried on choumoellier at Massey this year with rather surprising results. This implement, which is about 7 ft. wide, is driven over the crop at about 10 m.p.h. and is used extensively in America for cultivating maize until it is 6 to 8 in. high. It was used on choemoellier three times, at weekly intervals, and did surprisingly little damage to the crop although weeds were appreciably reduced. Its performance was sufficiently good to warrant a more critical trial next year. One definite point was established, however—it is of no use in wet weather or on wet soil.

In conclusion, it should be stressed that, apart from pre-emergence sprays which are still in the trial stage, there are no short-cut methods of weed control in supplementary feed crops. No doubt they will come, but until they eventuate crop yields can be considerably increased by giving more attention to detail during the preparation of the seed-bed, by ensuring a more uniform distribution of the seed over the field and a more precise placement of each seed in the soil and if necessary by checking weeds during the early stages of crop growth. In other words, by following more closely the long-established principles of cultivation and crop production.

DISCUSSION

Q:: *What are the nutritional values of sugar beet, mangolds, and fodder beet?*

MR. ROBINSON:: The nutritional values of these crops can be quite well judged by the dry matter percentage of each of them. Mangolds are the heaviest yielding and the poorest in quality. The dry matter in them is about 8 or 9 per cent. Sugar beet, the crop that is grown in overseas countries for the production of sugar, is the lowest yielding in tons per acre, but provides the best quality feed. The dry matter in that crop is between 20 and 25 per cent. Fodder beet, which were developed in Denmark and have been used in New Zealand for about ten years, are intermediate between mangolds and sugar beet. They were bred by crossing mangolds with sugar beet, and their yield normally is intermediate with the dry matter content usually ranging from 15 to 18 per cent. As far as we have been able to judge from the samples grown in plots at Massey, the yield in terms of tons of dry matter per acre is greatest from fodder beet.

Q:: *With reference to Mr. Robinson's list of crops for autumn use, no mention has been made of pumpkins. They are usually associated with flat ground, but so far nothing has been told to the hill country farmer about crops that he could really grow to alleviate facial eczema. Even with crops like choumoellier and kale the hill country farmer cannot giant disc, and Dr. Filmer and Dr. McMeekan said that small patches of grass would contain a certain amount of ryegrass. It is impracticable to fence those bits. Last year we tried pumpkins, which were a great success except that*

we put them in a bit too late. It seems to me that there is a place for pumpkins for the hill country farmer on a river flat paddock which would be a lot more fertile because it is used as a holding paddock. Our experience has been that hoggets will eat the unripe pumpkins without breaking them up. When the pumpkins start growing there is no chance for any ryegrass at all. Before they start running, if one puts in a reasonable mob of sheep, they will not touch the pumpkins, but will graze round them. We found that was much better than using a Planet Junior. This seems to me much more practical for a hill country farmer. Perhaps Te Awa would try out pumpkins and give us a report at next year's meeting?

MR. ROBINSON:: Pumpkins are normally a winter crop. As the speaker mentioned, if sheep are turned in on them in the autumn they will eat only the grass that surrounds them, so in this case where we are considering crops that are required for autumn use I do not consider pumpkins to be of great value. The second point is that, as the speaker mentioned, pumpkins require a soil of high fertility which is not available to the same extent on hill country as on the flats. The third point is that pumpkins are relatively low yielders in terms of feed per acre, and it was for that purpose that I suggested that choumoellier and possibly kale followed by fodder beet might be three crops which could be used in the autumn period, crops which, I think, will all grow well under conditions where pumpkins would grow, and yet give more feed.

A MEMBER:: I do not know how long the facial eczema scare lasts anywhere else, but last year we were still shutting sheep up when our pumpkins were ripe, and I do think that, even though there might be a low yield, they are supposed to provide a fairly well-balanced diet when fed with hay. I think that if a hill country farmer has a good supply of hay, a paddock of pumpkins used in conjunction with it, and fed out on the bare patches—because the affected sheep have to be put on a bare patch straight away, and there are any number of holding paddocks which are bare—might be the answer.

Q:: *What troubles are caused by various insect pests on crops?*

MR. ROBINSON:: Unfortunately, the members of the cabbage family which I have stressed are rather prone to attack from insect pests. There are three common ones, aphides, white butterfly, and diamond-backed moth. One of the main reasons why I chose choumoellier as possibly the best general-purpose crop was that it is rather less susceptible to attacks by them than the other crops. Rape, for instance, apart from being a crop that does not hold for any length of time once it is mature, is particularly susceptible to aphis attack, as also are swedes, especially in warm districts. There are possibilities of controlling these insect pests by dusting but it has not yet been practised on a field scale to any great extent. However, the Franklin Farm Improvement Club last year used the helicopter for dusting their crops against aphis, which, in most districts, has been the most serious pest. As far as the other crops are concerned, the fodder beet in particular is not, fortunately, damaged by insect pests to the same extent. The cruciferous crops are the ones that suffer the most.

Q:: *With regard to feeding animals on fodder beet. I know of cows that have been fed on it and which have died through nitrite poisoning. Is it, therefore, safe to feed sheep on fodder beet?*

MR. ROBINSON:: As far as I know it is. I have not heard of any troubles from it when it is fed to either sheep or cattle. Nitrite poisoning has

occurred with mangolds. It has usually been used for feeding to stock as winter feed, but I have known of instances where it has been fed to cattle in the autumn through the dry spell—dairy cattle for maintenance of milk production. I have not any instance I can quote of sheep being fed on it in the autumn in this country, but the leaves of the fodder beet are very similar in composition to those of sugar beet, and they are used in Britain regularly for winter feed for stock. Mangold leaves, of course, cannot be fed to stock.

[NOTE:: A member of the audience later reported having fed sheep successfully on fodder beet in the autumn and that it was both palatable and nutritious.]

Q:: *I should like to ask Mr. Cross his opinion of the rotary cultivator behind the crawler tractor as against the giant disc method used at present. Giant discing can take a considerable time, and if it is started a bit late it can sometimes be very late in the season before the crop can be sown. It might be possible to get the crop in much quicker with the rotary cultivator.*

MR. CROSS:: My recommendation as far as the use of the rotary cultivator is concerned is that it is a very useful piece of equipment and fulfils a useful function. If you can afford it, it will do an excellent job for you, but it is not by any means the cheapest way of preparing the soil for a crop. It will, in some instances, allow you to get the crop in, where otherwise you may miss out because of the delays caused by wet weather earlier in the season. It has the ability to prepare a seed-bed, so it is claimed, in one operation, but if this is done a very weedy seed-bed will result. In pumice country, in Tokoroa, one of our farmer-friends has had a rotary cultivator for about four years. It is a dairy farm and he puts in choumoellier every year. Up till this year he has always followed the correct principle of using it, that is, allowing sufficient time after the first cut for weeds to germinate, and then making another cut with the rotary cultivator which will kill those weeds and complete the seed-bed. This year he slipped a bit. He says he went into it with his eyes open. He gave it two cuts, one directly after the other, and as a result he has only half a crop—weeds choked the rest. It is not a very economic way of preparing soil because it is working rather against the weather instead of allowing the weather to help. Under those conditions the application of power to the process of directly producing the tilth cannot be as cheap as conventional methods. As I said before, if you can afford it, it is a very useful tool.

Q:: *Could you tell us how to get rid of rushes in a pasture?*

MR CROSS:: That is a difficult question. First the field must be adequately drained as wetness is the main cause of rushes. Plough them under deeply. In a pasture that has been sown down and is coming back to rushes the rushes can be ripped out fairly effectively, provided the pasture is reasonably smooth and has not been too badly pugged, by towing over the field three railway irons hooked together so that the leading edge of each iron hits against the rush. Return in the same track and hit it again on the opposite side and it will be found that about 75 per cent. of the young rushes will be knocked out. Rushes have been controlled by sprays—that account has been written up in a recent issue of the *N.Z. Journal of Agriculture,* and I would suggest you contact your extension officer for further details.

PLANNING FOR ALTERNATIVE FEEDS TO PASTURE

N. WATSON*

OTHER CONTRIBUTORS TO THIS SYMPOSIUM on farming autumn pasture dealt mainly with technical knowledge related to some of the many aspects of the problem. However, this paper is concerned with the problem in relation to the farm as a whole. It will not therefore deal with technical knowledge as such, but rather will seek ways and means whereby this knowledge may be used to best advantage in the varying circumstances in which the individual farmer may find himself. In this connection it can truthfully be said that no two sheepfarmers' circumstances are quite alike and, in point of fact, there are usually wide variations from farm to farm in such things as the soils, climate, topography, and other factors associated with the land; in the labour and machinery available; in the numbers, classes, and qualities of the livestock; in the particular farmer's personal aptitudes, inclinations, and responsibilities; and, last but not least, in the amount of money and credit available to each farmer.

It will readily be seen, therefore, that there can be no one single answer to this question of planning for alternative feeds. This paper is therefore written in general terms with the double objective of providing a few ideas on the subject and in the hope that it may as a whole prove of some use as a basis of reasoning towards successfully solving the particular problem on each individual farm.

There are two questions basic to the stock feeding plan on any sheep farm in New Zealand:

(1) Should alternative feeds to pasture be provided?

(2) If alternative feed is to be provided, how can it best be done?

Should Alternative Feeds to Pasture be Provided?

The experience of many farmers over the last two seasons will leave little doubt in their minds that feeds other than pasture must be provided as a regular practice. However, in other cases, the issues are not so clear cut. What then are some of the factors to be taken into account? These can be discussed under three headings.

THE PECULIARITIES OF PASTURE AS A STOCKFEED ON THE PARTICULAR FARM

There is no doubt that, under our farming conditions, pasture is by far the best and cheapest all-round basic feedstuff. It must always provide the main plank in any stockfeeding plan, and nothing that is

**Senior Lecturer in Sheep Husbandry, Massey Agricultural College, Palmerston North.*

said here about providing alternative feeds should be allowed to obscure this principle. In fact, one might go even further and say that the success of any sheepfarming venture will be very largely proportional to the degree in which pasture can be made to contribute satisfactorily to the total needs of the livestock. However, it remains equally true that the pasture can, and often does, have the following kinds of insufficiencies as far as the stock needs are concerned:

(1) Imperfectly balanced distribution of feed production over a normal season in relation to stock requirements, thus making it necessary, if the most profitable level of intensity of stocking is to be maintained, to provide alternative feeds for the lean periods.

(2) Marked but unpredictable variation both in the total amount of pasture feed produced from year to year, and in the pattern of growth within each year. Here again, if profitable levels of production are to be maintained, this will mean that either stock numbers must be adjusted to allow for such variations and/or alternative feeds must be provided in an endeavour to even out these variations and insure against loss in unfavourable seasons.

(3) Variations in the feeding qualities of the pasture herbage from the point where it represents a completely balanced diet to where it is actually toxic to animals. In these circumstances it becomes necessary to provide alternative feeds if the animals are not be either starved or poisoned.

In this paper, the main concern is with (3)—the problem of providing feeds for use when pastures are dangerous. However, this problem cannot be viewed in isolation. Constant attention must also be given to the other viewpoints; planning for alternative feeds must take into account any quantity as well as quality deficiencies in the pastures on the particular farm.

It will therefore be seen that the degree of need for alternative feeds varies as between farms, because of the peculiarities of the pastures grown. This, in turn, is due to such varying factors as the natural conditions of soils, climate, and topography; the state of development of the farm—in particular the level of "fertility" of the land, and the class of pastures; the intensity of the stocking relative to these natural and induced conditions; the classes of stock carried; the day-to-day grazing management.

It is not proposed at this stage to elaborate, or speculate any further on these factors, other than to summarize by saying that the need for alternative feed is likely to be greatest on farms where the natural or induced fertility level is high, where the stocking is intensive relative to this fertility status, and where there is a tendency towards persistent hard grazing of the pastures.

The Practicability and Economics of Providing Feeds Other than Pasture

Quite obviously there are limitations to what it is either physically possible or economically advantageous to do on farms comprising

steep hill country where machines cannot be used to any extent. Again, limitations may be imposed by such factors as shortages of labour, suitable machinery, and/or money. In such cases reliance must be placed on what can be done with grazing management alone plus, possibly, the use of a limited amount of purchased hay.

Serious thought also needs to be given, on the steeper country, to the best overall degree of intensity of farming to adopt. Is there not a danger today, in some instances, of developing the land beyond the level of maximum economic return? Is there not a possibility that, having gone just so far, it will then pay to resist one's natural inclinations and the exhortations of those who cry production for production's sake, and limit the intensity of the farming to something more in keeping with the land resource available and the general balance of the system of farming? Higher carrying capacity and production will not necessarily pay best in every case, either from the individual farmer's or national viewpoints.

Even when the farm comprises flat and easy low country, where it is physically possible to do much towards the provision of alternative feeds, it is still necessary to consider the economics of doing so. As always with individual farm problems, there is considerable difficulty in working out precisely the costs of providing alternative feeds in relation to the benefits accruing. However, common-sense reasoning, in round figures and over a period of time, will usually provide a "near enough" answer where detailed calculations might serve only to confuse the issue.

The Risks Involved in Relying on Pastures Alone as a Stockfeed

This is another very necessary way of looking at this problem. The attitude of farmers to risks varies considerably, as also does the ability to assume or carry risk. The more important factors to be weighed up here are:

(1) The magnitude and frequency of any loss likely from facial eczema or other causes.

(2) The problems and costs of providing informal insurance against these losses, such as reserves of alternative feeds and flexible stock arrangements.

(3) The ability to assume risks—*i.e.*, stand up to the mental, physical, and financial strain.

In this last respect it will be apparent that an established farmer in a secure financial position can take greater risks than another farmer with high liabilities still struggling to get established on his farm.

How Best Can Alternative Feed be Provided?

Having considered some of the principles which can be applied in deciding whether or not the farming pattern should be modified to include alternative feeds to pasture, we can now assume that a

decision has been made to do so. The next problem is how best can this be done? This will be considered by briefly outlining some of the more basic requirements in planning for alternative feeds and by considering, in greater detail, some of the advantages and disadvantages of the various alternatives—hay, silage, crops, etc.

Principles in Planning for Alternative Feed

The first principle in planning for alternative feeds is, as with all farm management problems, to consider the particular resources of land, labour, capital, etc., available in each case. In this connection it is pertinent to set out just what these factors required for production are, namely—land; improvements to land (grassing, layout, buildings, etc.); livestock; farm requisites and seeds, fertilizers, etc.; money; machinery; labour; technical knowledge; and overall management.

All of these factors vary from farm to farm both in themselves and in the way in which they are combined. Hence, when making decisions regarding the stock feeding plan, it is necessary to study the peculiarities of the situation in the particular case, and then to select and weave in such crops or other stock feeding plans as the available resources are best fitted to.

The second principle in planning for alternative feeds is that the provisions made must fit, or be made to fit, smoothly into the overall pattern of the farming. There should be no sudden major upset of a long established order of things. In particular, the production, storage, and feeding of the alternative feedstuffs must complement or supplement other activities on the farm and not compete with them for the use of the available resources of land, labour, machinery, and personal attention. For example, the growing of a crop of mangolds is unlikely to fit in on many farms. With this crop the thinning and cultivation compete with other and more important operations on the farm such as shearing, weaning, drafting and drenching lambs—and even annual holidays.

Similarly, some winter crops (for example swedes) tend to compete for land, as the paddock is left bare during the critical early spring when it would be helpful to have it in pasture.

On the other hand, we find that some alternatives work in better. For example, the taking of a hay or silage crop can often profitably supplement the use of a paddock or two of the farm at a period of the year when otherwise the areas would largely be wasted. Likewise, with suitable management, the feeding out of these crops can supplement the full utilization of labour in the autumn and winter months.

A further point is that hay and silage work in well with choumoellier. If fed out to the stock on the paddock which is to be ploughed up next for the choumoellier crop, the fertility of the soil will be raised and the yield and usefulness of the choumoellier crop correspondingly enhanced. In this way the hay or silage crops may have a use other than in themselves, by complementing the choumoellier crop.

It will be seen, therefore, that any plans for alternative feed must work in to the best advantage.

The third principle in planning for alternative feeds is that whatever plans are made they must be flexible. This need for flexibility arises from the fact that, in making plans for any one season, there is no way of determining in advance exactly what the requirements will be for that particular year. Thus a crop such as rape, which is very critical both as to time of sowing and feeding, is unlikely to be of much use. On the other hand choumoellier, which is very flexible regarding sowing date and also feeding, is likely to be much more suitable, especially as, if it is not required in the summer/autumn period, it may be carried over for use in the winter. Silage is even more flexible than choumoellier, in that if it is not required in one year it may be carried over for use in the next or even retained for several years. Hay, if it has been stored safely, is equally as flexible as silage and has the added advantage that it is easier to sell off the farm if, ultimately, it is not required.

Advantages and Disadvantages of Various Alternative Feeds

The main crops and other feedstuffs of value under North Island conditions are:

Choumoellier

Silage

Hay

Saved pasture

Purchased feedstuffs—concentrates, etc.

Choumoellier

This is undoubtedly the best general purpose forage crop for use on sheep farms. It is the most reliable and also the most flexible, both in time of sowing and feeding. Also it yields well under a wide range of conditions, although it does not like "wet-feet." It is relatively easy to feed off, although in some circumstances difficulties can arise. Again, in spite of requiring a fairly heavy fertilizer sowing for best results, it is a cheap and easy crop to grow. It therefore works in well in most sheep farming systems in relation to the stock feeding plan, the re-grassing programme, and the organization of labour and work over the year.

A *minimum* of 10 acres of choumoellier per 1,000 ewes can be considered a "must" on practically all fat lamb farms in the North Island. This crop should be sown, in districts such as Manawatu/Rangitikei and Southern Hawke's Bay/Northern Wairarapa, mainly as a winter crop, but also with a view to late summer/autumn use. So that the crop may have a sufficient degree of maturity for feeding the lambs at the time when facial eczema conditions are most likely to occur, it is advisable to sow some two or three weeks earlier than if it is being sown purely for winter feeding purposes.

Silage

In spite of its smell and the problems in handling it, ensilage is going to play a much more important part in the sheep farming programmes of the future than most of us realize. Its advantages are:

Higher protein content and better feeding qualities generally than average quality meadow hay.

Very great flexibility in all respects—it can be harvested in all weathers and stored for long periods.

No capital expenditure required in the form of barns, etc., for storage.

Most important of all, it can be made to fit in well with pasture management.

The disadvantages are:

Problems in handling—both in harvesting and feeding out.

Smell.

Lack of saleability if not required on the farm.

Silage has, of course, never been accepted to any extent in the past in sheep-farming circles. This has been due to the disadvantages listed, together with the widespread misconception, mentioned by Schwass (see page 57) that there is difficulty in getting sheep to eat it, and that they will not thrive on it. These ideas are quite wrong. Silage for sheep is used quite successfully at Massey College. Two North Island sheep farmers are known who use it successfully. Further, it is understood that it is being used to a considerable extent in Canterbury.

The problems in handling silage are well known. Mr. Cross has emphasized in his article (p. 63) that very considerable progress has been made in mechanizing silage making, and further advances are in the offing. However, it is this feeding out problem which is the limiting factor to the widespread economical use of silage on sheep farms. When this is overcome silage will have a very useful place in many intensively run sheep units.

To make the economic use of new silage-handling machines possible on the smaller sheep units, it may be necessary to encourage the setting up of silage contractors in the various districts. This possibility should not be overlooked when considering silage in relation to farming programmes.

Hay

Hay is already widely used on North Island sheep farms and particularly in the plains areas of Hawke's Bay and Wairarapa. Its principal present uses are as a means of assisting the handling of the spring flush of grass, and as a means of providing alternative feed for sheep in the summer/autumn and winter periods. However, it is considered that it could be used to advantage on many more farms as an insurance against quality and quantity insufficiencies in the pastures and also, in some districts, against the risk of snowfalls. In all

districts where the climate is suitable for harvesting hay, it fits well into the more intensive farming systems.

As already mentioned, hay is also a very flexible feed, as it may be kept for several years without loss of quality if safely stored, and ultimately, if not required, it can also be sold off the farm.

While discussing hay it is pertinent to mention lucerne. On farms where the rainfall is low and the soils are light and of low moisture-retention capacity—*e.g.*, Central Hawke's Bay and parts of the Wairarapa, there is a definite place for a stand of lucerne in the stock feeding plan. Again about 10 acres per 1,000 ewes are suggested, not as a substitute for choumoellier, but in addition to it. Such a stand may be used in a variety of ways, but the first two cuts each season are usually best made into hay or silage, and the crop can then be judiciously grazed over the summer/autumn period, when it will provide useful, although not necessarily, safe feed from the point of view of facial eczema.

Mention should also be made here of some points in using hay on hill country units. On the steeper country generally hay is not likely to play an important part in stock feeding in a normal season. Its use in a normal year will, in fact, be confined to feeding a few bales a day to the weaner cattle in late winter/early spring, as much with the idea of quietening them as for its feeding value. However, where there is risk of droughts and/or cold late springs, hay should be provided as insurance against being forced to sell cattle on a depressed market, or, alternatively, to hold and lose them—together with considerable sleep. Insurance in this way would enable greater risks to be taken with cattle, and thus enable pastures to be managed to better advantage. To use hay successfully in this way, some careful thought is required, and also a little capital expenditure. Several small hay barns should be built at strategic points on the farm—these being sited in relation to access for carting hay out to them in the summer, and also with regard to ease of hand feeding out in winter.

Saved Pasture

No discussion on stock feeding plans is complete without reference to saved pasture and it is dealt with here, as an alternative to pasture, because it should be treated as a crop rather than as pasture in the ordinary sense.

The commonly used and indispensable type of saved pasture is the autumn/early winter saved variety. However, there is a very useful place for late spring/early summer saved pasture, at least on the heavy and medium-heavy soil types under moderate rainfall conditions.

To make best use of summer saved pasture, it is necessary either to sow special-purpose short-rotation/red clover pastures, or to make a regular practice of sowing down all pastures with a general-purpose mixture, containing principally permanent pasture ryegrass and white clover but also sufficient short-rotation ryegrass, and broad and Montgomery red clover to have a good showing of these species over

the first few years. Of the two methods the latter one fits best into most sheep farming organizations except, of course, where it is intended to harvest ryegrass and white clover seeds. Late spring/early summer saved pasture strong in red and/or white clover is extremely useful as a fattening feed for tail-end lambs, for growing out replacement ewe hoggets, and for flushing ewes. There can, of course, be no guarantee that saved pasture like this will be safe from eczema, but at least there is less risk than with close-grazed, fast-growing paddocks.

Purchased Feedstuffs

The purchased feedstuffs which may have some use on North Island sheep farms are sheep and linseed nuts, peas, molactrate, and molasses. The first four have a high energy and protein value, and it is the latter quality which makes them useful for feeding in conjunction with hay, which is low in digestible protein. These concentrated feeds, although costly, have a use for valuable stud sheep and cattle, and they may also have a limited use for feeding to flock sheep. Their high cost is, to some extent, offset by certain advantages—*e.g.*, they do not have to be produced on the farm; all that is required is sufficient cash or margin of credit to buy them. Thus they have little or no cost in years when no alternative feeding is required, and in the years when they are needed they can be purchased in just the amounts required. Further, they are easy to feed and fairly balanced as a stock ration.

Possible uses under flock conditions are:

(a) For feeding with hay to ewes if facial eczema precautions must be taken at the flush of tupping.

(b) If (a) is judged to be uneconomic, then perhaps the feeding of these concentrates might be justified for boosting the tail-end, poor-constitutioned ewes which could be drafted off and fed separately.

(c) In unusually bad years when feed conditions become desperate.

The other purchased feedstuff likely to have some use is molasses, which is extremely palatable to sheep and has a high energy value but is very low indeed in protein. Its uses are thus somewhat limited, but it may serve in helping to introduce sheep to hay or other dry feeds.

Some General Observations

The first of these concerns two rules which arise from the fact that sheep which have been accustomed to pasture all their lives do not take kindly, or quickly, to a sudden change on to alternative feeds, especially hay and silage.

These rules are:

(a) On farms where the need for the alternative feed is likely to arise at a time when the nutritional needs of the sheep

are high, as for example, facial eczema conditions at tupping time or a heavy and prolonged snowfall just prior to or during lambing, then, as an insurance, the ewes must be introduced and trained to the feeds before these events actually occur. In other words, the sheep must be "geared up" to the plans and needs of the farm in advance.

(b) As far as possible, alternative feeds should be used at the times of the year when the sheep's needs are relatively low, both as to quality and quantity, and that during these periods the pasture be saved for use at other more important times.

The second observation stems from the two rules just given. It concerns feeding plans and practices on fat lamb farms which are subject to fairly regular and severe drying out in the summer months and which are also subject to severe facial eczema conditions from time to time. The question which should be asked is: Are the present practices of summer grazing and facial eczema precautions on this class of country as sound as they might be? Should not the shutting up of the ewes on a small area and a limited amount of alternative feeding be done as a regular practice at the onset of the dry period before pasture growth completely stops?

This idea would appear to be sound, at least in principle.

It would serve as an introductory period for the ewes to hard feeding at a time when their nutritional needs are low. They would thus be geared up and, in the event of eczema precautions having to be taken at tupping time, would receive less of a setback.

The spelling of most of the pastures at this time would also appear to have a number of advantages. For example, more pasture cover to check the rate of drying out, less damage to pasture species, particularly short-rotation ryegrass, and quicker and possibly safer recovery when regrowth commences.

By confining the breeding ewes at this time to a very small area of the farm, there would be even greater scope for fattening tail-end lambs and cast ewes, while still retaining a large area of the farm shut up.

The third observation is that this question of planning for alternative feeds is not something that should be viewed just from the limited angle of the increasing incidence of facial eczema and other results of quality deficiencies of pastures.

There must be taken into the perspective the other changes in the constantly moving pattern of external conditions under which farms must be operated. Such current trends as:

(1) The market changes which are resulting in much earlier drafting of lambs and the uncertainties regarding orthodox cattle farming practices.

(2) New scientific and technological knowledge—*e.g.*, aerial farming, and hormone sprays.

(3) Improved mechanization, such as the harvesting machines discussed by Cross (see p. 63) and the new tillage machines he discussed (see p. 96).

All these must be studied, and ways and means found of profitably marrying them into a pattern of farming that must still remain founded, in the first instance, on past experience.

DISCUSSION

Q:: *Has pampas any place on the sheep farm?*

A:: I think that pampas is somewhat limited in its uses. Yet I do know of several cases where it has been used successfully for feeding both sheep and cattle, particularly dairy cattle, and also run cattle. I know of a case where wethers are wintered on pampas fed in conjunction with choumoellier crop, and wintered very successfully, too. However, pampas is costly to establish and it needs good ground which generally can be better used for pasture. It can have some use for beef cattle as a reserve for bad years, but I think that hay is a much better proposition; that is, organized hay reserves on the system I have suggested.

Q:: *I have been interested in silage making for a number of years, and have used silage to fill gaps in the feed supply, particularly for winter feeding, and, as Mr. Watson has advised, early in the winter, and not immediately prior to lambing. I was interested in Dr. McMeekan's statement about the effect of feeding silage, although it may have been hay, on the weight loss of closely stocked sheep in the facial eczema trials at Ruakura. The early loss in weight seemed to pick up as the feeding progressed. I found that the sheep to which I fed silage lost much weight and that eventually it was necessary to provide nuts for feed. I think the material from which I made the silage might not have been high enough in protein. Would Mr. Watson mind giving his views on that?*

A:: I think there is a possibility that the quality of your silage was not as good as it might have been. I agree, however, that average quality silage needs to be fed in conjunction with something else—I do not think it is sufficient on its own for sheep. Perhaps at this stage I should mention some aspects of one case I have come across where silage has been fed this autumn as a precaution against facial eczema. The farm concerned comprises some 200 acres of clay downs country in the Mount Stewart area, wintering 930 ewes and 100 other sheep—in other words, a small but fairly typical and well-managed Manawatu fat lamb unit. The stock feeding plan in recent years has comprised, in addition to pasture, 10 to 15 acres of choumoellier, gleanings from a cash crop of 10 to 15 acres of peas, and a little meadow hay. However, for several years the farmer has been weighing the merits of silage as an addition to his farming plans. With this end in mind, he acquired a buck-rake last year to fit to the Ferguson tractor he already owned. After drafting his lambs early, he was able, in addition to shutting up a paddock for hay, to save an eight-acre area of young balanced pasture for silage.

Little difficulty was found in harvesting the crop. The farmer did this on his own, fitting it in between various other jobs on the farm and cutting

just as much as could be handled in the time available each day. As it happened, this was the one season in every three or four when the silage was really needed. With the onset of facial eczema conditions in March, it was possible to shut up the 930 ewes for a total of six weeks, feeding eight bales of hay per day together with about 1½ tons of silage (a big trailer load). This works out at about ½ lb. of hay and 3 to 4 lb. of silage per ewe per day. It is of interest to note that the total amount of silage from the eight-acre paddock was fed during the six weeks.

The silage was of good quality and there was little difficulty in getting the sheep to take it, although at first they were a little slower in taking the silage than the hay. However, once they got used to it they really relished it and came through the six weeks' period very well indeed. The only criticism the farmer has from this experience with silage is the labour in feeding out. He admits he found this pretty hard work and he hopes it will be possible to mechanize this operation in future.

Q:: *Could Mr. Watson give us the benefit of his knowledge of the feeding of silage from the forage harvester? Is it easier to cut in the silo than normal hay is after it has been totally compressed? Does he find there is any advantage in silage made from the forage harvester?*

A:: I have not had any personal experience of forage harvester silage, but I understand from what I have heard from various dairy farmers—we use a forage harvester, for example, on the dairy farm at the College—and also from what I have heard from Mr. Cross, that it is much easier to take out of the silo than when it is made in the ordinary form.

Q:: *Could you tell us how thousand-headed kale and collared kale compares with choumoellier?*

A:: I am not a specialist on the cropping side. There are people here better qualified to speak about crops as such. For example, Professor Hudson is here, and there may be some of his field husbandry staff. From the little I know about kale, however, I do not think it is as good as choumoellier. It appears on the surface to have greater flexibility as it is supposed to stand at least three feedings, recovering from each of these—or that is the story I have been told. However, in practice this does not work out, and in many districts there are also many problems in getting sheep to take kale in the first instance. Somebody else may care to add something to what I have said in this connection.

THE CHAIRMAN:: *Referring to an earlier speaker who, I understand, had fed silage by itself, what is his experience? Were there 1 or 2 per cent. of his sheep who never took to it—did not like it at all?*

A:: Yes, there was that difficulty. The first time I fed silage I was advised that it would be difficult to get sheep to take to it, so I used molasses as an appetizer. In the first season or two I merely went round with a watering can and put a weak solution of molasses on the silage. It certainly attracted the sheep. As you suggest, however, there is a tail-end which, even after days of feeding out, were loath to take to it. Naturally, they tended to fall off in condition. I used the technique of feeding at one end of the paddock and once the sheep which would take the silage were all up there I was able to sort out these tail-enders, which I then grazed normally.

MODIFICATIONS TO PRESENT-DAY TILLAGE PRACTICES

M. W. CROSS*

NEW ZEALAND'S ECONOMY AND WELFARE depend primarily on exports of agricultural produce, derived mainly from pasture converted by animals into meat, wool, or dairy produce. Thus, before any treatment which may affect pasture production is accepted, it must be critically examined and proved. Further, the inherent conservatism of many farmers, backed by years of traditionally sound practices, makes them rather chary of revolutionary ideas—at least until those ideas have a sound practical backing.

Although our pastures as a whole are world renowned, many fall well below the category of high-producing ones and a marked increase in production could be achieved through a general improvement in their standard. This improvement can be effected by following the traditional and well-founded method of ploughing and resowing. But the high cost, and probably the extra work involved in these operations, are deterrents to many who might otherwise be interested in such improvement.

During the past ten years, considerable interest has been aroused in the possibilities of producing crops—grass and other forage or grain crops—without the expenditure of the considerable time and money necessitated by conventional tillage practices. The concept of "once-over" cultivation and seeding and of "double-cropping" is not new. These systems involve the seeding of crops into the stubble of previous crops without any additional cultivation treatment. It has been our aim to ascertain whether or not certain of these short-cut methods, which are accepted practices in localized areas of the world, have a wider and more general application.

In certain areas of eastern England it is a fairly common practice to follow the binder or header with a disc-seeder (a set of one-way discs fitted with seed and fertilizer boxes), sowing into the stubble a quick-growing green-feed crop for use either as sheep feed or green manuring. On the prairies in Canada, a similar machine is used to sow, in the spring, the coming season's wheat crop into last year's wheat stubble without any other tillage operation. In America, a six-year study has resulted in a practical and economic method of double-cropping being evolved. In one instance this entails the direct overdrilling of the wheat stubble left by a header with soya beans.

In America and Australia, pastures have been renovated by drilling in grass seed, or clover, or both. Winter grazing from pastures has

**Senior Lecturer in Field Husbandry, Massey Agricultural College, Palmerston North.*

been supplemented by direct overdrilling of green-feed cereals during the autumn. Green-pea crops drilled into pasture have been successfully grown and harvested. Lucerne has been established in sheep grazing pastures. Phalaris has been directly drilled into untouched stubbles and established satisfactorily. These are a few only of the many examples that could be quoted. With such an encouraging background it is not surprising that interest should be aroused in New Zealand—and it undoubtedly has been aroused.

Overdrilling for Pasture Renovation

Overdrilling for pasture renovation has long since passed the experimental stage. One has only to talk to farmers from almost anywhere in the North Island and from many parts of the South Island to learn of the successful exploitation of this method. Admittedly, there have been a number of indifferent, or sometimes negative results, but this can in most cases be attributed either to the lack of a suitable machine or to the use of incorrect methods. There have been so many successful results that it is not the theory that is at fault but the application.

Last year, in conjunction with Grasslands Division, D.S.I.R., a replicated trial of seven treatments covering about three acres was laid down on the moderately fertile soil of the Massey College dairy farm. The object was to compare existing methods of oversowing (broadcasting) and overdrilling short-rotation ryegrass on a clover dominant

[photo.: H. Drake.

On this area the ryecorn was overdrilled into the stubble in a once-over operation. Note the regrowth from some of the previous crops supplementing the introduced crop. Height of crop 8 in.

[photo.: H. Drake.

On this area a seed-bed was prepared by ploughing, discing and harrowing and rolling before the ryecorn was drilled. Height of crop 5 in.

pasture, and to gain some measure of efficiency of the methods used. In all cases seed was sown at 6 lb. per acre and superphosphate at 2 cwt. per acre.

One of the most spectacular results to come out of this trial was the futility of broadcasting the grass seed over an untreated pasture.

Another was that good results could be obtained, provided that climatic conditions were favourable, by broadcasting seed and fertilizer over pastures which had been surface cultivated to a greater or lesser degree by discs or harrows. This entailed three to six trips over the field.

And yet another was that equally good—if not better—results could be obtained by drilling seed and fertilizer into the untouched closely-grazed pasture in a once-over operation. For this, standard seed and fertilizer drills with slight modifications were used.

Further experience with the drills used in this trial and with imported "sod-seeding" machines has resulted in a better understanding of the requirements necessary for the successful establishment of overdrilled grass and clover.

Competition from existing grasses, clovers, and weeds must be reduced by all possible means, such as:

¶ By hard grazing the pastures just prior to sowing, and if necessary, up to the time that the seeds have germinated.

¶ By the use of wide furrow-opening coulters which provide a plant-free track into which seed and fertilizer are sown.

[photo.: H. Drake.

A comparison between overdrilling the stubble (left) and drilling into a prepared seed-bed (right half). The crop is Cape barley photographed three months after sowing on March 21. Although there is no apparent differences in the two plots, the overdrilled area was done in a once-over operation.

¶ By regulating the depth of sowing so that at all times the seed is covered by no more than ½ in. of loose soil—not by a turf mat.

¶ By sowing in the autumn when competition is less than in the spring, and by sowing sufficiently early in the autumn to allow the grass or clover to become firmly established before winter.

The management of the overdrilled pasture must be to allow the undisturbed growth of the young seedlings. For overdrilled ryegrass on dairy farm pastures, grazing should not be permitted until the seedlings are about 6 to 9 in. high. A lesser height would be desirable for sheep pastures. With overdrilled clover, the pasture must be grazed and the existing species kept short enough to allow plenty of light to penetrate for vigorous clover growth.

Although it is most desirable to spell pastures which have been overdrilled with grass, very little loss of grazing is incurred when compared with a cultivation programme. Also, there is likely to be much less pugging during the first winter, and the risk of erosion is negligible. This latter aspect is interesting soil conservators in many parts of the world.

Despite the wide variety of machines used—and many of these are home constructed—there have been sufficient successful results in widely separated districts to indicate that pasture renovation by overdrilling can become an integral part of our farming system. There is

little reason for a pasture to deteriorate at all—at any rate on reasonably fertile land. Whenever certain species become a bit thin, whatever the reason, they can be reintroduced easily and cheaply by one trip over the field. Red clover, for example, dies out after a year or two but can readily be re-established by overdrilling. The same applies to Italian, short-rotation, or perennial ryegrass. Weeds can be controlled by pasture sprays and suitable stock management. All things considered, it would appear that the need for ploughing can be very considerably reduced, particularly on light soils or where deterioration is only partial—provided, of course, that a machine is available which will do the job of overdrilling correctly. This is the limiting factor at the moment.

Machinery for Overdrilling

Although there are a variety of adaptations and modifications for existing machines on the market, and even a limited number of sod-seeders from overseas available, none of this equipment really completely copes with our conditions.

Hoe Coulter Drills

Hoe coulter drills may be fitted with Blackmore tips. These tips perform well in friable soils and reasonably open pastures and gave excellent results in our trials. After a grass grub attack they are generally very suitable.

But penetration is limited in hard ground. The pasture needs to be closely grazed and bare to prevent blockages by trash and to assist penetration. The tips require frequent building up on the points to maintain efficiency. Unless very precisely fitted, they twist the coulters. On dense surface mats, such as paspalum or old browntop swards, they do not leave a sufficiently wide plant-free track to reduce competition from the existing species. And on very rough ground the independently mounted coulters seldom, if ever, have sufficient free movement to follow the major irregularities without damage to the drill. But for all that they fulfil a useful service in many instances.

Disc Coulter Drills

Disc coulter drills have become quite popular and they also perform well under the same conditions as the hoe coulter drill. One added advantage is that they have the ability to cut through surface vegetation and will not block with trash to the same extent as the hoe coulter. Penetration is generally sufficient under all conditions, provided that the pressure springs are adjusted accordingly.

But the main disadvantages of the disc drills are that penetration is very uneven in most soils and some type of depth skid is essential; that the angle or concavity of the disc blade is insufficient to tear out the slice of turf and so leave a plant-free track. What generally happens is that the discs lift a lip of turf, deposit the seed and fertilizer, and the turf then falls back into place. This is disastrous to the seedlings which find great difficulty in emerging. If they do finally struggle through, they are often so exhausted that they succumb to local competition and early grazing. One must get away from the

idea of introducing the grass seed without disturbing the existing sward. For best results an open, continuous furrow up to about 2 in. wide should be left and the seed covered with soil and broken-up turf brushed over it by chain harrows.

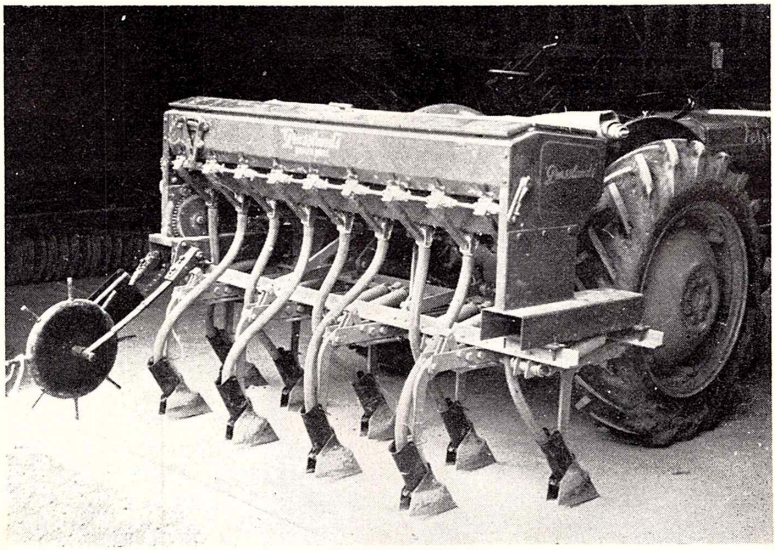
A small scraper fitted at the rear of the disc blade of these drills will do the job of dislodging the turf but brings added complications. Also the range of independent movement of the coulters is insufficient for very rough ground and damage to the drill can occur. Even so, many excellent results have been obtained.

Disc Seeders

Disc seeders, comprising seed and fertilizer boxes mounted on a single gang of disc harrows—or for rougher, tougher going, on giant discs—with tubes directing the seed and fertilizer into the groove on the reverse side of the disc, is another promising approach. The space between two disc blades on each gang may be filled with blocks of wood to within 1 in. or 1½ in. of the edge of the blades and they then act as wheels and limit excessive penetration. Sufficient angle may then be applied to ensure consistent penetration and scooping out of a well defined groove. The main disadvantage is that the gangs are rigid across their width and bridging will occur on uneven ground.

Sod Seeder

One Australian sod seeder comprises a seed and fertilizer box mounted on a spring-loaded, rigid-tine cultivator fitted with special furrow-opening shoes. A track about 2 in. wide is burst open by each tine, the seed and fertilizer deposited in it, and coverage with



An Australian sod seeder which was used for sowing the trial plots comparing overdrilling with a prepared seed-bed for a variety of green crops.

soil effected by trailing chains. This machine has been developed for Australian conditions and has a reasonably wide application in New Zealand, but does not provide the real answer. As it is a rigid tine cultivator, the tines do not follow surface irregularities, although if obstructions are encountered they can slide over them.

On relatively smooth surfaces, this limitation is of little moment, but is a definite handicap on rougher going. Also, on thick turf the burst-open furrow tends to heal over too quickly—especially after a shower of rain. The effect is to shade or smother the developing seedlings.

Grassland Drills or Pasture Renovators

Two leading American farm machinery manufacturers have marketed within the last five years "grassland drills" or "pasture renovators." These are essentially robust seed and fertilizer drills and, although intended primarily for sowing into undisturbed ground, can be used for arable sowings. One type is provided with a special furrow opener which places fertilizer at one depth, cereals at a lesser depth, and grasses and clovers still shallower. Scrapers cover the fertilizer with soil before the seeds are sown, so protecting them from damage.

However, this machine is expensive, does not follow surface irregularities, and does not provide the type of furrow considered most suitable for the majority of New Zealand conditions.

A further limitation of most of the machines mentioned is the lack of suitable seeding mechanisms to handle the wide range of seeds—at the equally wide range of seeding rates—sown on farms. This is overcome in some instances by providing separate seed boxes for major seed changes, but at extra cost. It does seem rather wasteful and unnecessary to provide three separate seed boxes when one should suffice.

There are many pastures throughout the country which can be successfully overdrilled with existing available machinery. But if the technique is to be more fully exploited and if other short-cut methods are to be developed, particularly on our rougher land and where erosion risk occurs, we must have machines which will cope with our specific requirements. Judging from the response so far, interest among farmers is increasing and New Zealand manufacturers will find a ready market for such a machine—which they are capable of producing. Already two, and possibly three, manufacturers have the problem in hand. The outcome of their endeavours should be available this coming season.

For universal application such machines will have to be suitable for flat or hilly country with smooth or uneven surfaces; be robust enough to tackle virgin ground or burnt-over scrub and yet be suitable for drilling arable land; be able to sow a wide range of seeds at an equally wide range of sowing rates; be able to place those seeds at the desired depth, continuously and evenly in a plant-free track; and be within the price range of both the smaller, as well as the larger, primary producer.

Overdrilling for Pasture Establishment

Other variations of overdrilling have been explored at Massey College this season. A pilot trial was undertaken to compare overdrilling of fed-off choumoellier with the conventional practice of ploughing and cultivation prior to laying down the new pasture.

When the cultivation portion was ploughed, one ¼ acre plot was overdrilled with a 30 lb. seeding (the same as was sown with the roller-drill on the prepared seed-bed 3 weeks later). The choumoellier had been cut with a mower prior to grazing, and the tine coulter machine which was tried was abandoned because of excessive blockages due to choumoellier stalks and weeds. A disc coulter drill cut through this trash satisfactorily and the area was cross-drilled diagonally—half the seed being applied each way. Fertilizer was sown with the seed.

Germination was rapid, although the ground was not particularly moist. By comparison the grass and clover on the cultivated area (which was sown three weeks later, this time being required for cultivation) did not emerge for approximately two weeks after sowing owing to the lack of rain. In this instance it was felt that considerable moisture had been lost during ploughing and cultivation, but was retained on the overdrilled area. At the first grazing, yield cuts from both areas were taken. Excluding weeds, which were heavier on the overdrilled area and composed almost entirely of fat hen (*Chenopodium album*), there was a 1,000 lb. per acre increase in green

[photo.: H. Drake.

A typical example of the results obtained from overdrilling (with a disc drill) short-rotation ryegrass into a clover dominant sward. The right half has been untreated. Photographed two months after sowing. The trial area had already had one grazing with dairy cows.

[photo.: H. Drake.

Clover establishing satisfactorily in a short-rotation pasture after overdrilling in the early spring. Photograph taken about two months after drilling.

weight from the overdrilled area. Unfortunately, barley had been drilled at ½ bushel per acre as a cover crop in the cultivated area, but only a sprinkling was sown on the overdrilled portion, and this somewhat obscured the results. However, a comparison of the dry matter yield per acre of ryegrass showed that it was well established on the overdrilled area—the weights being 420 lb. dry matter per acre compared with 70 lb. dry matter per acre from the conventionally sown area. There was only a trace of clover from both sowings.

After grazing, the overdrilled plot was topped with a mower. This cleaned up the fat hen left standing after grazing, and since then it has largely disappeared. Although cross-drilled in 7 in. rows, the intervening spaces are filling up and little bare ground is apparent. The area has now had two grazings—with cows—and is entering the winter very much more firmly established than the cultivated area.

An improvement of this method would probably be to overdrill grass alone as the crop is fed off. There is no reason for waiting until the whole field is cleaned up, as each quarter or third is grazed it could be overdrilled. The subsequent stand of grass could then be allowed to establish thoroughly without worrying about smothering the clover, and be treated as autumn-saved pasture for late winter or early spring feed. After grazing in the spring, clover could be overdrilled and the grass kept short. By about November or December there should be a satisfactory balance of grass and clover. This has been the experience with overdrilled clover at Massey College.

Another application of this technique could be applied where the forage crop is fed-off in the winter. A complete pasture mixture could then be overdrilled in the early spring.

One aspect which appeals, particularly on light land, is that by overdrilling the fed-off crop there is no loss of the consolidation already achieved during the growing of that crop. It seems pointless to break up a naturally consolidated field, then turn around and endeavour to consolidate it artificially before sowing to grass.

The question of weeds is sure to arise. If the choumoellier, turnips, or other forage crop is sown in wide rows, intercultivation will be required for weed control if a reasonable yield is expected. If the crop is drilled in 7 in. rows, or broadcast, or better still sown with the roller drill in 3 in. rows, the seed should be thick enough and sufficiently evenly distributed to ensure a complete cover of the field by the crop at the earliest possible time. This shading will inhibit weed growth. Correct cultivation practices before sowing will also contribute materially to weed control.

When the crop is fed-off and the grass overdrilled, weeds will germinate wherever the ground is broken—in this case only along the rows. Weeds will not usually germinate on the undisturbed ground between the rows. If weeds are troublesome they can be readily controlled in the early stages by pasture sprays, or by use of the mower after the early grazings.

Much hill country, broken-in and sown to a forage crop, could well be established in pasture by this means instead of re-discing, etc. The risk of erosion would be eliminated and both time and cost of the operation considerably reduced.

Double Cropping

An additional application of overdrilling, without special preparation of the soil, is "double-cropping." Following the removal of an arable crop, whether cereal or forage, it is common practice to sow the area in green feed, either for green manuring, winter grazing, or some other specific requirement. Conventional methods dictate the use of the plough, discs, etc., and the crop is drilled into a freshly prepared seedbed. More recently, particularly in the South Island, ploughing has been dropped and the seedbed prepared by discs or cultivator followed by harrrowing and rolling before drilling.

At the College this autumn, an area on which ten different crops had been growing was used to compare direct overdrilling with conventional tillage. These crops were maize, ryecorn, wheat, oats, barley, peas, lupins, linseed, millet and rape. The crops were removed and half the area was ploughed and worked down to a conventional seedbed; the other half was left untouched. Five different green-feed crops were drilled, using an Australian sod seeder, at the same seed rate on each half. On the overdrilled half, no difficulty was experienced from blockages by the straw left after the barley, oats, etc., and the seed was sown between 2 in .and 3 in. deep. Germination was more rapid on all the overdrilled treatments, and from observations to date

they have kept ahead of those on the ploughed area. In addition, seed shaken from a number of the previous crops has germinated and supplemented the introduced crop. In the ploughed area little, if any regrowth has occurred. Weeds are insignificant in both plots.

An added advantage may be expected in the following spring. If the stubble is ploughed for the green crop it will have to be deep enough to bury the trash. When reploughed in the spring at the same depth, weed seeds turned under with the stubble are brought to the surface and will probably re-infest the spring crop. By overdrilling the stubble and ploughing once only, a cleaner seedbed for the spring crop should result.

Another exploratory trial at the College is the introduction of green-feed cereals into pasture to supplement winter grazing. This has been done successfully in certain areas of U.S.A. Plots of ryecorn, black barley, and oats were overdrilled this autumn, 1956, again using the Australian sod seeder, into a vigorous pasture to observe the growth in competition with the pasture species. Germination was satisfactory, the areas have been grazed twice but it is yet too early to draw any conclusions.

* * *

In conclusion the following points should be emphasized.

If overdrilling is to be practised, then the correct technique must be followed. Due consideration must be paid to the germination and growth requirements of the introduced seed if good results are to be achieved. This dictates the use of a suitable machine.

Results so far experienced from overdrilling have been as good as, and in some cases better than, those experienced with conventional methods of sowing. Drastic reductions in time and cost of field cultivations are afforded by the once-over operation. In consequence, completely revised grazing and cropping programmes are not only possible but practicable.

The potential offered by the exploitation of these abbreviated cultivation methods demands their fullest investigation.

ACID RESISTING CEMENT

ROLANDSHUTTE ALUMINOUS CEMENT

Ideal for floors, bins, stoves, flues, hoppers, sumps, drains, dams, piles, posts, etc.

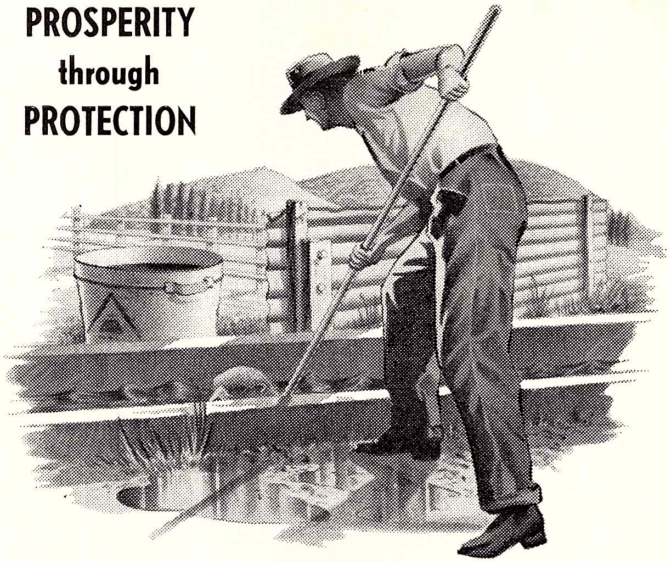
EASY TO USE
RESISTS LACTIC ACIDS
HARDENS RAPIDLY
WITH GREAT STRENGTH

"Further particulars from"

JOHN BURNS & CO. LTD.

Customs St. East, AUCKLAND

PROSPERITY through PROTECTION



At all times of the year, sheep require careful attention. Blowfly, foot rot, lice and ticks must be eradicated in order to safeguard the wool clip, and through this, the national prosperity.

YOUNG'S Sheep Dips have been used with confidence by sheepfarmers for many years. The name YOUNG'S is in itself a guarantee of the very highest in quality. No other brand of dip gives all the features embodied in the YOUNG'S range.

FARMERS . . .

Call in at your local Farmers Co-operative Association and see Young's full range, guaranteed to give your sheep really efficient protection.

FOR HEALTHIER SHEEP USE

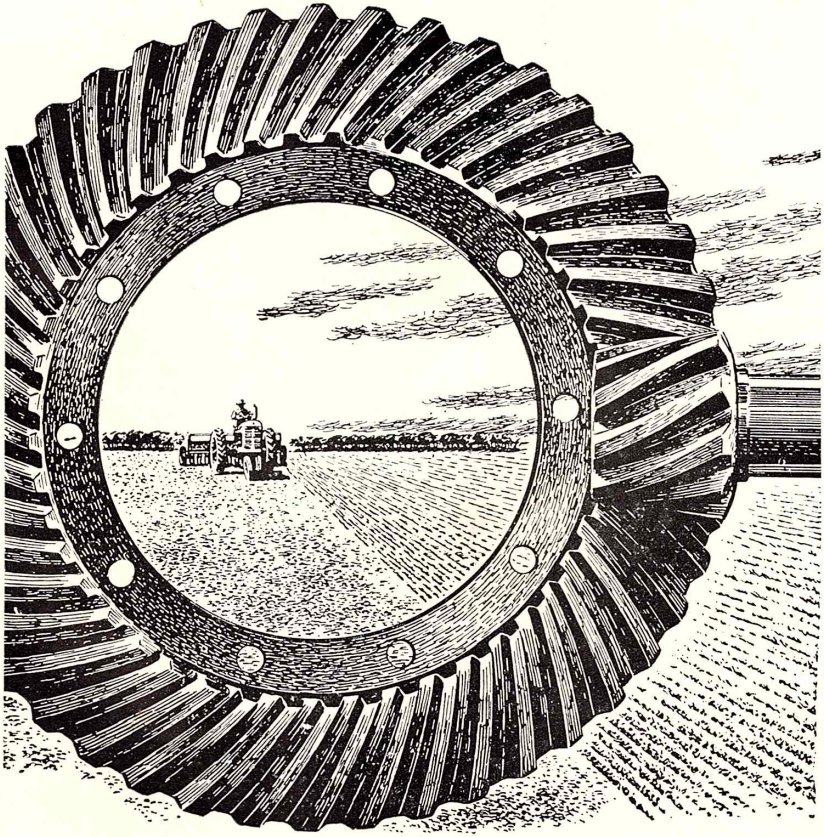
Young's SHEEP DIPS

Distributed through: Farmers Co-op. Wholesale Federation (N.Z.) Ltd., Box 1124, Wellington.

Food is a question of mechanics

Maximum production from the land is essential to the well-being of farming communities and to the *physical and economic security* of entire nations. Agriculture is a *basic industry* that requires the best from men and machines . . . the right combination of farm mechanization and sound soil conservation practice.

Whether crops are grown for food or fibre . . . whether farms are measured in tens or thousands of acres, McCormick International Farm Tractors and Farm Equipment have the power and flexibility to improve every phase of the growing cycle from seed bed preparation to harvest. Here are the tools of mechanized agriculture. Their ability to revitalize farming production is shown by documented records of successful performance.



SEE YOUR LOCAL IH COMPANY DEALER FOR FULL FACTS

INTERNATIONAL HARVESTER

INTERNATIONAL HARVESTER COMPANY OF N.Z. LTD.

Branches and Dealers throughout New Zealand

Fig. 1: Bottle jaw.

ABOUT WORMS IN SHEEP

DAISY B. FILMER AND E. A. CLARKE*

PERHAPS ONE OF THE MOST UNPOPULAR SUBJECTS of discussion among sheep farmers, apart from facial eczema and income tax, is that of "worms." While we should hesitate to decry this interest in worms, we do feel that they are generally the target for far more criticism than they deserve. So often worms alone are incriminated when sheep are coughing or scouring or are generally ill-thrifty. It is true that worms may cause an animal to exhibit some or all of these symptoms, but so often the real cause is some other organism, or is nutritional in origin.

The purpose of this paper is then to indicate:

(1) What true worm parasitism is.
(2) How it may be recognized in the field.
(3) When drenching is necessary and would be most beneficial and economical.

All worms of sheep are parasites and require one or two hosts—one of which is the sheep. They may be allotted to one of three categories which for simplicity will be called: Tape-worms, flukes, and round worms.

**Research Officers, Ruakura Hill Country Research Station, P.B., Frankton Railway.*

Perhaps the most spectacular worm of sheep is the common tape-worm called *Monezia expansa*. Most farmers will have seen the white segments of this worm in the dung of lambs. However, in spite of its enormous length, which may be 30 to 40 in., it is probably little more harmful than three feet of macaroni. It has never been shown conclusively to be detrimental to the growth of lambs, so that its removal by drenching would seem unwarranted. Usually, by the time lambs are 6 to 7 months old they will "shake off" most of these tape-worms without any treatment. In short, these worms are not a problem in sheep.

Fasciola hepatica, the common liver-fluke of sheep, can, however, cause extensive damage to livers. It is fortunately found only in isolated areas of New Zealand and is probably unknown on many farms. Associated with fluke infestation is the disease known as "black disease." Fortunately ,the diagnosis and control of this parasite are well known.

Round worms, on the other hand, are found to some degree in all flocks throughout New Zealand and are, therefore, of more general importance than either flukes or tape-worms. Accordingly, the remainder of this paper will be devoted to the round worms of sheep.

Although some of these parasites are capable of killing sheep, most of them have little effect on healthy animals. Some round worms are capable of producing, in even the healthiest sheep, a very severe disease which often leads to death. These are called "primary parasites." The majority, however, present a problem only when animals are reduced to poor condition by some other predisposing factor and these are therefore called "secondary parasites."

Primary Parasites

The only worm of sheep in New Zealand which has been assigned to this group to date is that called the barber's pole worm (*Haemonchus contortus*). Young sheep are particularly susceptible to this worm, which may attack and kill hoggets either in prime or in poor condition. Older sheep in good condition, on the other hand, are usually resistant to its attack. Outbreaks of haemonchosis may occur, however, in ewes during times of stress, such as pregnancy and lactation. Ewes, rams, or wethers confined to a small area and on a lowered plane of nutrition (*e.g.*, during facial eczema periods) are also likely candidates.

The barber's pole worm is probably the most important worm parasite of sheep in New Zealand. Its occurrence is very widespread, although small areas in the South Island seem to be free of it. The adult worms are up to one inch in length and live in the fourth stomach. They may be easily recognized in this organ of a freshly killed animal by their striped appearance, which is responsible for the name "barber's pole." They suck blood from the wall of the stomach at an estimated rate of approximately 15 ml./1,000 worms per day. A severe infestation could remove many pints of blood per week. It is

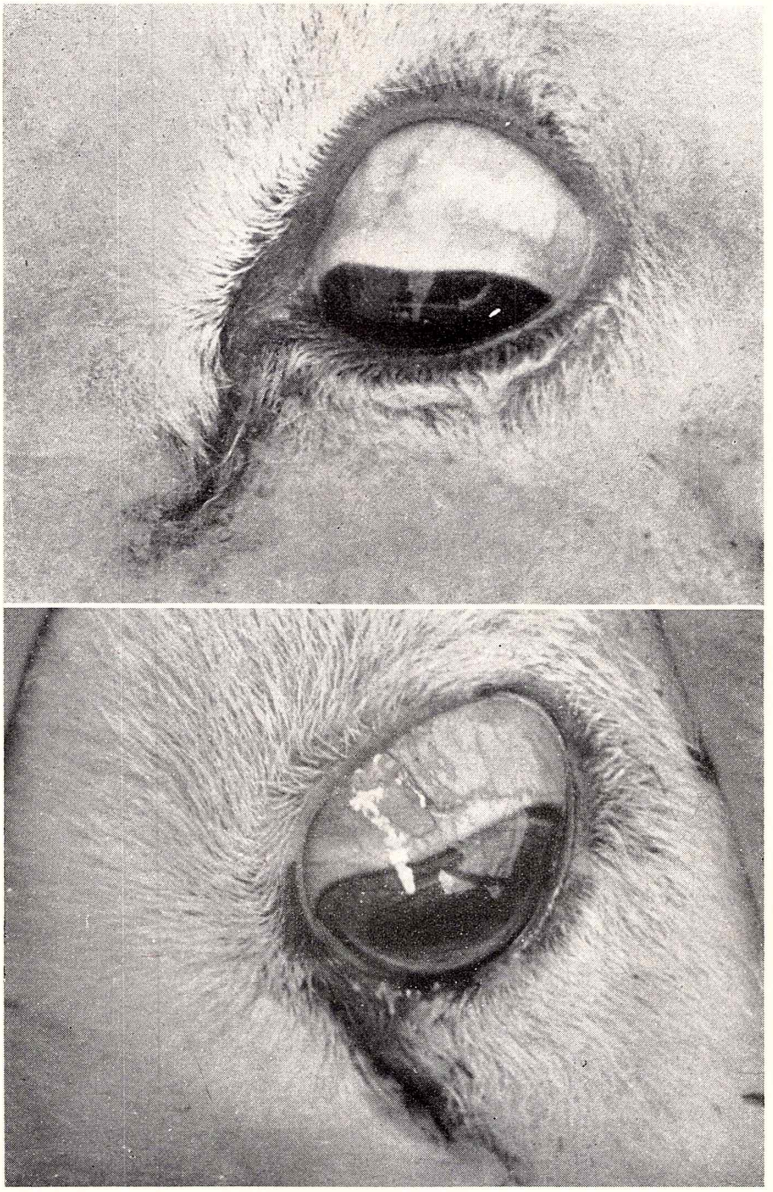


Fig. 2: Anaemic eye (top) and normal eye (bottom).

not surprising, then, that a heavy burden of these parasites could render an animal very anaemic in a short period.

Outbreaks of haemonchosis in young sheep should always be anticipated in summer and early autumn. Two to three weeks following rain between January and the end of April approximately, hoggets should be inspected frequently. Fortunately, haemonchosis can be easily diagnosed in the field by the farmer. Affected animals are usually listless, difficult to drive in a mob, and anaemic. Anaemia is diagnosed very simply by inspecting the eyes and gums of a few hoggets in the flock.

As *Haemonchus* will attack even the best hoggets, the eyes of some of these, and not only of those in poor condition, should be examined. The eyes and gums of an animal in which the disease is well established and serious are very pale (Fig. 1). The eye has lost its bluish colour and the blood vessels are almost invisible—hence the term "paper white eye." (Fig 2.) A large pad or lump may be present under the jaw. This condition is called "bottle jaw." The eyes of animals not so severely affected may not be "paper white." Their blood vessels may be visible but contain a very pale and watery looking blood. This anaemia, which develops rapidly in sheep in both good and poor condition, is characteristic of haemonchosis. It is not associated with infestations of any of the other round worms of sheep in New Zealand.

Secondary Parasites

All other round worms of sheep in New Zealand, as at present identified, may be classified as secondary parasites. *Trichostrongylus* or the black scour worm is probably the best known of these. As was the case with *Haemonchus,* hoggets are far more susceptible to secondary parasites than are older sheep. Unlike primary parasites, however, these worms rarely present a problem when hoggets are in good condition. Young sheep, lowered in resistance by any predisposing factor such as hogget ill-thrift, pleurisy, pneumonia, or poor nutrition, will often die from exposure to secondary parasites.

These worms may live in either the fourth stomach or the intestines. They are quite small and often difficult to see on opening the gut. Unlike *Haemonchus,* they do not suck blood but derive their nutrients from the contents of the stomach or intestines. Secondary parasites do not give rise to the rapidly developing anaemia seen in haemonchosed sheep.

Secondary parasitism as a disease is difficult to diagnose. It is impossible to differentiate between its symptoms and those of the predisposing factors which have rendered the animal more susceptible to parasite attack. These parasites are most prevalent during the autumn and early winter months. It is during this period also that hoggets are frequently low in condition from hogget ill-thrift and other diseases which render them more susceptible to these parasites.

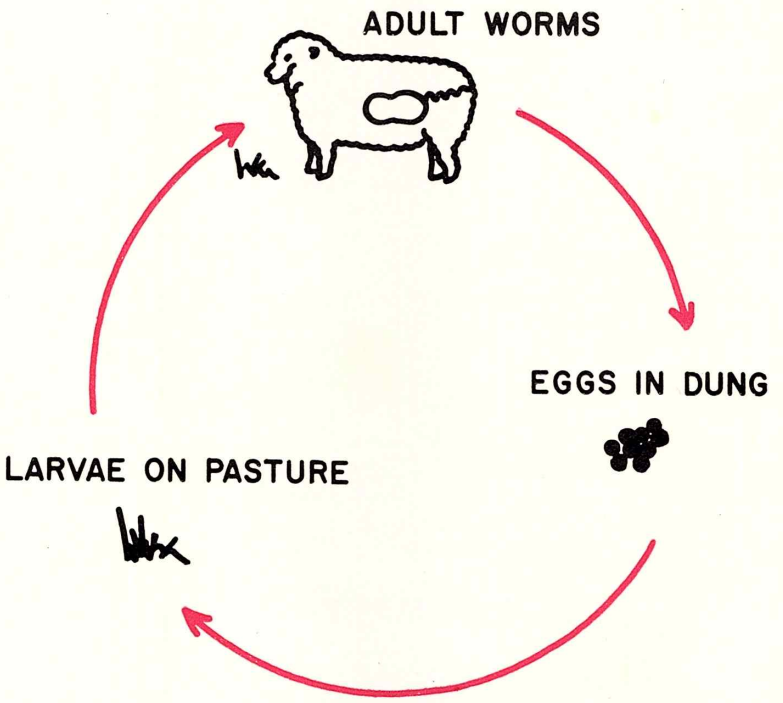


Fig. 3: Life cycle of round worm.

Between about February and June, then, hoggets in poor condition should be suspected of harbouring burdens of these parasites which may be likened to the last straw which broke the camel's back. On the other hand, thrifty hoggets in the same flock will be able to resist heavy burdens without even a loss of weight.

Life Cycle

In the treatment of diseases such as parasitism, it is necessary to break the life cycle of the worm at the easiest or weakest point. All round worms of sheep have a simple life cycle requiring the one host only—*i.e.*, the sheep. Figure 3 demonstrates a typical life cycle of these worms. It will be seen that there are three stages of the worm each spent in a different environment.

The eggs which are laid by the female worms pass out of the sheep in its dung. They are usually oval in shape and invisible to the naked eye. Warm, humid conditions in the dung are essential for the hatching of the eggs, which normally takes place 3 to 5 days after leaving the sheep. Sterilization of sheep dung to kill these eggs has proved successful in stalls and yards but is obviously quite impracticable in the paddock.

After hatching from the eggs, the larvae or young worms migrate up and down blades of grass in a film of moisture until eaten by some grazing animal. They must have moisture in the form of rain or dew for this migration. During periods of drought larval migration may be greatly reduced. If not eaten in a certain time, these larvae may die, so that spelling of a pasture from stock may lower its degree of infestation slightly. This is, however, by no means entirely efficient in the eradication of these parasites. There are reports of paddocks remaining contaminated with round worms in spite of spelling from sheep for over twelve months.

As the majority of these worms are specific to sheep, a large proportion of larvae will be destroyed if ingested by other stock. Cattle run with or behind the hogget flock can be useful disinfecting agents in this respect. Older sheep, being usually resistant to these worms, may also serve the same purpose as cattle if grazed on a paddock after hoggets. Once again, of course, this method of lowering the degree of infestation of an area can never be totally effective.

After the larvae are ingested by the sheep they make their way to their respective parts of the digestive tract—*i.e.*, fourth stomach and intestines—where they develop to adult males or females. A period of 18 to 22 days passes before an ingested larva matures to an egg-laying female. These adults, depending again on their species, may vary from about $\frac{1}{8}$ to 1 in., and are round in cross-section—hence the name of this group.

The number of eggs laid by these females varies according to the species of worm. *Haemonchus* is perhaps the most prolific, with a daily output of about 5,000 eggs per female. It is therefore little wonder that even a moderate burden of *Haemonchus* is capable of seeding a pasture with millions of eggs per day. It will be appreciated that these parasites are incapable of multiplying within the sheep but depend for propagation on the completion of this life cycle.

The easiest and most successful method of breaking this life cycle is by killing the adult worms within the sheep. Many drugs have been tried—the two best known being bluestone-nicotine and phenothiazine. The use of bluestone-nicotine is not advocated. The efficiency of this drench depends on its going direct to the fourth stomach. The presence of bluestone in this drench causes the oesophageal groove to close so that the drench passes directly into the fourth stomach and not into the paunch or rumen. It has been found that in about 10 per cent. of cases bluestone fails to stimulate the closing of the groove and the drench passes into the paunch. Diluted by the paunch contents, bluestone-nicotine is ineffective. Thus, about 10 per cent. of the hoggets are virtually undrenched. Further, it is only about 50 to 60 per cent. efficient against *Haemonchus* and even less effective in the destruction of the other round worms.

Phenothiazine, on the other hand, is practically 100 per cent. effective in the removal of *Haemonchus,* and when finely ground has a much higher efficiency against secondary parasites than any other

drug. It is to be emphasized that the cost of the drenching materials is not the only charge in drenching sheep. Time and labour are also considerable items.

Drenching Programme

No rigid drenching programme would be appropriate for every farmer in New Zealand for every year. It would be very dangerous to recommend that all sheep throughout New Zealand, or even in any one district, should be drenched annually to a strict timetable. Conditions favourable for an outbreak of parasitism vary from year to year, from district to district, and indeed from farm to farm.

The following points should be borne in mind when the drenching of sheep for round worms is contemplated:

(1) Rain during hot weather will enable the larvae of these round worms to migrate from dung up the grass blades.
(2) Larvae develop to adults two to three weeks after ingestion by sheep.
(3) Adult worms are more susceptible to drenches than the immature worms.

Our suggestions for drenching, then, would be:

Control of Haemonchosis

If haemonchosis is diagnosed, all animals in a flock should be drenched immediately and every two to three weeks thereafter until it has been controlled. The disease should be anticipated as follows:

(a) In young sheep two to three weeks after rain between January and April approximately.
(b) In any sheep which have been restricted to a small area and a poor level of nutrition as in facial eczema periods.
(c) Occasionally in pregnant and lactating ewes.

Control of Secondary Parasitism

(a) During the autumn all poor hoggets should be suspected of harbouring secondary parasites. In the absence of *Haemonchus,* poor hoggets only and *not* the whole flock should be drenched at monthly intervals. In districts where haemonchosis is not a problem, or in years unfavourable to its development, drenching of poor hoggets over the autumn may be all that is necessary.
(b) If hoggets are drenched before being introduced to clean pasture or a crop, the degree of infestation of the paddock will be reduced.
(c) Phenothiazine should be used in preference to bluestone-nicotine.
(d) Having greatly reduced the parasite level of the sheep by efficient drenching, it is foolish to return them to a heavily contaminated paddock. Following drenching, the sheep

should be changed to the least contaminated paddock available (*i.e.*, the paddock which has been cleaned up preferably by mature cattle) or a crop or hay aftermath, etc. It is to be pointed out, also, that grass in holding paddocks can be heavily contaminated with parasites.

Although drenching may have eliminated the parasites and perhaps saved the animal's life, an immediate response in body weight should not be expected. The blood of sheep which have had haemonchosis will return to normal only if the animal is provided with good feed. An increase in body weight should then follow. No improvement in growth rate can be expected after the removal of secondary parasites from poor hoggets unless the predisposing factor responsible for this low condition is also rectified.

Summary

Round worms of sheep in New Zealand are more widespread and of more economic importance than either tape-worms or flukes.

They may be classified as primary and secondary parasites according to their effect on sheep:

(a) *Haemonchus contortus* is the only example of these primary parasites in New Zealand. It may kill hoggets in both poor and good condition. Older sheep succumb only when their resistance is low. Its presence may be diagnosed by the paleness of the eyes and of the blood of affected sheep.
(b) Secondary parasites are a problem in poor hoggets only over the autumn.

Round worms have a simple life cycle which may be broken by killing the adult worms in the sheep by efficient drenching.

Drenching:

(a) Phenothiazine should be used in preference to other drugs.
(b) Following drenching, the sheep should be changed to the least contaminated paddock available.
(c) All sheep in a flock where haemonchosis has been diagnosed should be drenched immediately. This is often sufficient but it may be necessary to repeat in two to three weeks' time.
(d) In the absence of haemonchosis over the autumn, poor hoggets only should be drenched at monthly intervals.
(e) No immediate improvement in body weight should be expected following drenching. Furthermore, drenching will not cure hogget ill-thrift.

Diseases cease to be serious problems once methods of prevention and treatment have been evolved and are applied effectively. If, then, worm numbers are kept at harmless levels by providing sheep with a good level of nutrition and by drenching when necessary, these internal parasites should not present a serious problem to the farmer.

Ask for

JOHNSON'S

ENGLISH FENCING WIRE

STOCK OF PLAIN WIRE READILY AVAILABLE
At Stock and Station Agents and Hardware Merchants. JOHNSON'S WIRE is made expressly to last—drawn with the skill of 150 years' experience from carefully chosen steel, protected by PATENT HOT DIP GALVANISING the heavy coating of which ensures long life under New Zealand's climatic conditions. It is practically immune from the corrosive action of salt-laden air, whereas inferior, thinly galvanised wire needs constant renewing. Johnson's Wire is durable and will save you costly repairs, renewals and re-erections.

When you order Fencing Wire
insist on Johnson's

MADE BY
RICHARD JOHNSON AND NEPHEW LTD.
MANCHESTER ENGLAND

Sole N.Z. Agents:
JOSEPH NATHAN & CO. (N.Z.) LTD.
WELLINGTON AUCKLAND CHRISTCHURCH

NEW COMPLETE DIP

★ KILLS LICE AND TICK (KED) AND PREVENTS BLOWFLY WITH A SINGLE DIPPING.

★ PROVIDES PROLONGED KILLING POWER FAR GREATER THAN ANY PREVIOUS INSECTICIDE.

★ DOES NOT REQUIRE "TOPPING-UP" FOR STRENGTH—LEAVES NO ROOM FOR ERROR.

★ LEAVES WOOL CLEAN, SOFT, AND "EASY HANDLING".

Elliotts ALL-DIP sounds too good to be true—until you remember that it is based on an entirely different insecticide—Aldrin. ALL-DIP has power like Arsenic to poison by mouth; properties similar to Rotenone that kill through the skin; plus the power to stay lethal for months in the wool. ALL-DIP works down the fibre during growth, that's why it's so effective for so long. Elliotts ALL-DIP does not harm the wool. In addition it contains bactericides to protect against pus forming organisms and after-dipping lameness.

SAVES TIME, LABOUR AND MONEY

The great advantage of one muster—one dipping—for control against fly-strike, lice and tick (ked) attack, needs no emphasis. And because Elliotts ALL-DIP is so potent, one 5 lb. packet makes 200 gallons of .05 per cent. solution—enough for 400 sheep three weeks off shears. The ALL-DIP powder does not strip out below the recommended strength and the dip needs no topping up for strength.

ONE DIP — ABSOLUTE CONTROL
— FAR LONGER PROTECTION —

YOUR STOCK & STATION AGENT CAN GET YOU ELLIOTS ALL-DIP

Manufactured and Marketed by Elliotts N.Z. Company
Ellco Ltd., Onehunga, Auckland

REARING THRIFTY HOGGETS

E. A. CLARKE and DAISY B. FILMER*

THE REARING OF THRIFTY HOGGETS has long been regarded as a problem fraught with considerable difficulties. In some districts and in some seasons, losses have been very high. There are some properties where an annual death rate of up to 15 per cent. is regarded as normal and where, in a bad year, losses greatly in excess of this figure are regarded as inevitable.

This problem was first approached with the idea that the hogget was a "touchy" animal, very susceptible to checks from yarding and handling, and consequently a difficult subject on which to conduct intensive research.

However, five years of trials involving now some thousands of hoggets, individually identified and recorded, under a wide variety of conditions, have convinced us, *provided the feed conditions are right,* hoggets are extremely hardy and difficult to check by even the most extreme treatments. Excellent growth rates have been recorded in hoggets which have been mustered daily, weighed weekly and sometimes every two days, drenched fortnightly, sampled daily for rumen contents with the stomach pump, bled from the jugular vein at weekly intervals, carrying harness and dung bags, and so on. They have done well confined individually in small pens, and equally well in mobs in large paddocks. Even a broken leg has failed to impair seriously the growth of a hogget in one of the pen feeding trials. Lambs weaned at an average age of twelve weeks have subsequently grown as well as their comparable mates weaned a month later. Amongst the early weaned lambs were some as young as 50 days which grew as well as their older mates.

It is true, however, that the young animal lacks the resistance to some infections which has been acquired by the older animal. Outbreaks of scabby-mouth and haemonchosis in hoggets are examples of this lack of resistance in the young. It is also true in general that the animal which is growing well is better equipped to withstand many such infections. This does not, imply, however, that in the case of a severe disease, such as haemonchosis, remedial treatment should not be immediately undertaken unless the hoggets are in poor condition.

In another paper (see p. 109) *Haemonchus* was labelled a primary parasite. The other roundworms were labelled secondary in that they seriously affect only the hogget which is doing poorly from some other cause; the other cause appears to be most commonly the wrong type of feed.

Immediately after weaning, hoggets do well provided there is plenty of feed, and the more leafy the feed the better. Over this period the well-controlled pasture, providing the "short bite," is a fattening

**Research Officers, Ruakura Hill Country Research Station, P.B., Frankton Railway.*

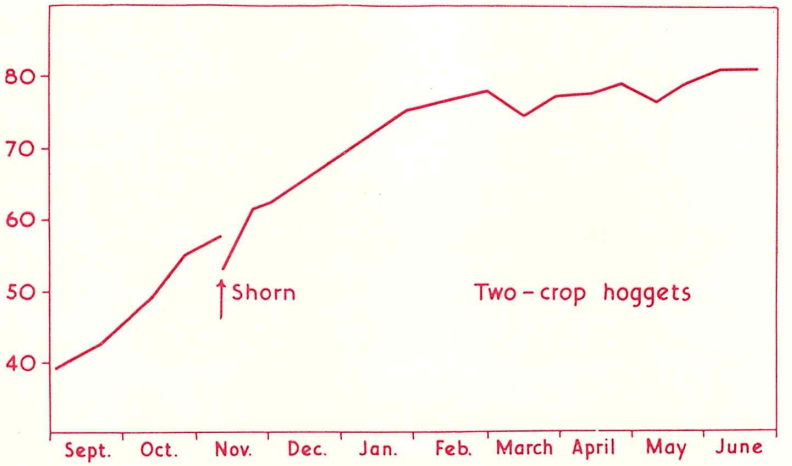


Fig. 1: Live-weight curve of lambs weaned in September.

feed *par excellence*. It seems to conform well to the textbook description of short leafy grass having a dry matter equivalent to that of a protein-rich concentrate. From weaning until about early March, hoggets do well on this class of feed and gain at the rate of up to about 4 lb. live-weight increase per week. On poorer quality feed, such as badly controlled pasture, they still grow quite well and

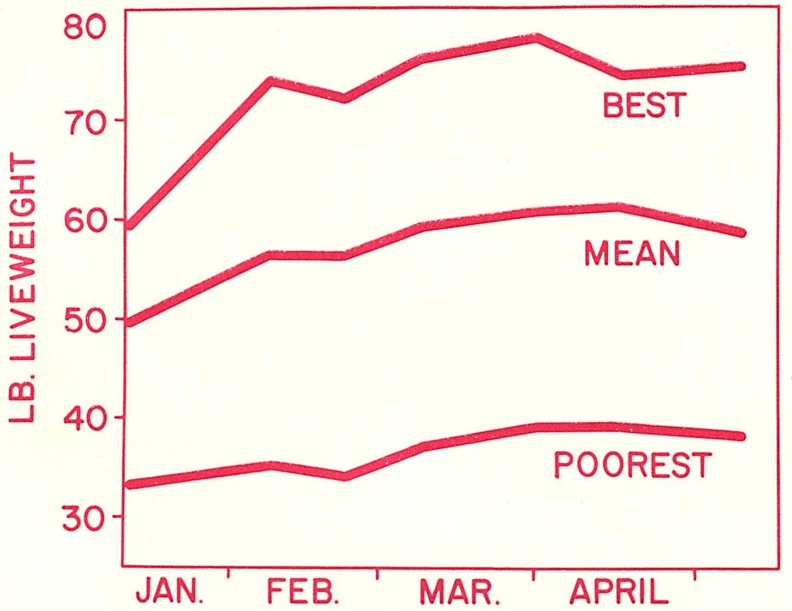


Fig. 2: Live-weight curve of lambs weaned in December.

a gain of 2 lb. a week may be expected almost irrespective of the class of feed. Where hoggets have failed to thrive over this period, the cause has generally been very evident and most usually due to a quantitative deficiency of feed or to very stemmy and dried up pasture of obviously very low quality. Throughout the dry summer period, the growth of hoggets is directly related to the quantity and leafiness of the feed and, provided these are adequate, the rate of stocking would seem to be of no importance.

Minor checks to hoggets over this summer period have been attributable to outbreaks of scabby mouth (contagious ecthyma) and to pink eye (contagious ophthalmia). The former complaint usually affects an individual sheep for little more than two to three weeks although it takes a month or more to run through a flock. It generally spreads most rapidly where thistles, young gorse, and similar plants prick the lips and muzzles of the grazing hoggets. A badly affected hogget may lose weight over a short period when the soreness of the lips impairs grazing. Fortunately, a cheap and effective vaccine is available. For the past two years all the lambs in the trials have been vaccinated at shearing time and no outbreaks of this trouble have occurred.

Pink eye is usually worst in a dry season and, although there is no clear-cut evidence, it is believed to spread most rapidly when feed is long and dry. This year it was widespread in the experimental hoggets and many were almost blind. Affected hoggets suffered a temporary check, some losing weight slightly and some making only small gains over a period of about two to three weeks only. Provided the paddock is free of hazards for blind sheep and the sheep are not unduly

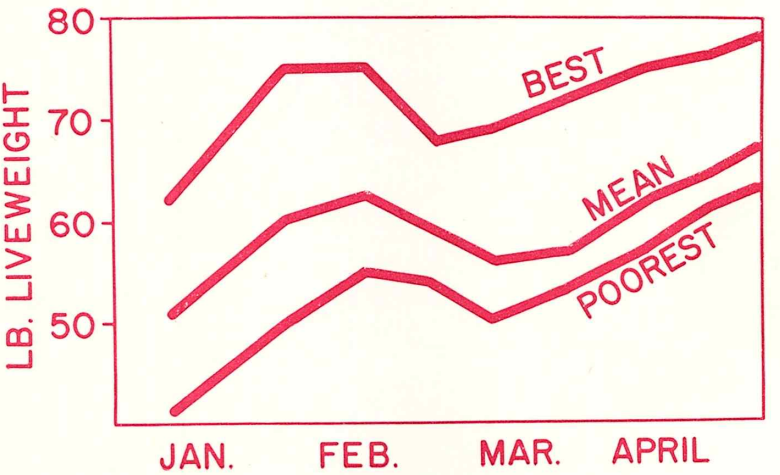


Fig. 3: Live-weight curve of lambs weaned in December.

disturbed, this disease cannot be regarded as a serious problem in hogget rearing.

Parasites are not likely to be a problem until the dry period has passed.

Three years ago, a warning was given that rickets in hoggets was a possibility in the North Island from about May-June onwards and that, when hoggets still failed to thrive at this time, rickets might be responsible and could be treated by a dose of one million units of Calciferol which would give protection for some three months. In spite of trade propaganda to the contrary, there is no evidence that Calciferol is beneficial for any other complaint or should be administered at any other time.

The real problem of hogget rearing commences when the rains start the autumn flush of feed. The onset of troubles may be as early as late February or as late as mid-April, and varies from district to district according to local conditions. This year, for example, it commenced late and was less severe than in previous seasons in the South Auckland district but was earlier and more severe in the Putaruru area where good growing conditions occurred in early autumn.

The fresh growth of feed commencing with the autumn rains is in some way incompatible with the good growth in hoggets and frequently a marked loss of weight occurs although feed is plentiful and, by usual standards, is of high quality. In the same paddock the pasture grown in the spring is frequently indistinguishable in stage of growth, rapidity of growth, and botanical composition from that grow in the autumn, yet hoggets grow well on the former, and poorly or lose weight on the latter. Figure 1 shows the live-weight curve of lambs born in June and weaned at the normal weaning age in September. On the same paddock throughout, they have grown remarkably well until the following March.

Figures 2 and 3 show the same effect in the autumn on hoggets weaned in December. Here is shown the mean live-weight changes for the group and also for the best and worst animal in the group. It is clear that the pattern is similar in each case. It has been found consistently that factors such as age, weight, or sex are of little or no importance. This check in live-weight increase has also been observed to occur in two-tooths and older sheep at the same time as it occurs with the hoggets (Fig. 4). It is noticeable that, where an actual loss in weight occurs, it is of similar order in all animals and consequently is proportionately more severe on the smaller animals. To this extent, the smaller animal is more severely affected. On these grounds, lambs should be treated as well as possible right from birth.

This failure of hoggets to thrive from early autumn onwards and frequently until mid-June or later has been termed "hogget ill-thrift." In its most severe form it results in extreme emaciation and a high death rate may occur. Hoggets post-mortemed after dying or being killed *in extremis* have presented a somewhat confused picture. They

may be found to have severe anaemia, abnormalities of the bones (especially the ribs which are more like cardboard than bone), fatty infiltration of the liver and/or scanty gut contents. In general, this is a picture consistent with starvation. In addition, various infections, both parasitic and bacterial, may be present as "last straws."

There is good reason to believe that this condition is due to the nature of the autumn feed and is not caused by any infection. Nor is it caused by any known mineral or vitamin deficiency. The role of gastro-intestinal parasites is now clear, since the disease has been produced at Ruakura in the absence of these parastes and, conversely, hoggets on *the right* feed have been kept thrifty in spite of heavy parasite burdens.

In all trials where pasture has been of a long, mature type during the autumn and early winter, good hoggets have been reared. Figure 5 shows the growth rate of hoggets on long feed contrasted with a group kept on the short leafy "fresh-bite."

There is still much to be learned of the cause of this starvation in the midst of apparent plenty. It is known that the intake of this short autumn feed is low both in the field and with the dried material fed to hoggets in pens. On short feed, hoggets occupy about twice the grazing time and enjoy only about half the idling, resting and cudding time of those on long feed. On short feed, much time is spent wandering about to graze, whereas on long feed the animals cover only short distances in grazing. Present studies at Ruakura are concerned with learning the cause of the lowered intake on short feed.

Ill-thrift in hoggets on short feed has been found to occur on all kinds of pastures and is not believed to be associated with any particular species of plants. Specifically, it has been found on pastures which were ryegrass and white clover dominant, paspalum dominant, browntop dominant, danthonia dominant, and in mixed swards of ryegrass, cocksfoot, clovers, Yorkshire fog, sweet vernal, etc.

Hoggets have been observed to be ill-thrifty on autumn crops, such as swedes, choumoellier, kales, and green feeds such as ryecorn. Generally, hoggets immediately do well when put on the crop. In some seasons they have done badly and have been removed and returned to the crop about a month later when they have done well. Our limited experience with crops, however, suggests that the ill-thrift on crops is due to immaturity of the crop and is the same ill-thrift as manifested by hoggets on short, immature autumn feed. The rapidity of onset and the spontaneity of recovery is the same in both cases. This year a crop of swedes gave a poor result about mid-March and a good result three to four weeks later.

Dairy farm pastures have given consistently good results in rearing hoggets. This is believed due only to the long and mature nature of the feed. In the two past seasons unthrifty hoggets have been produced on dairy farm pastures which were kept well controlled to produce the short, fresh bite.

The ideal autumn pasture for hoggets is the typical "autumn-saved" dairy pasture, 8 to 10 in. long and very leafy, and consequently

of relatively high quality. Mature rather than long would perhaps be a better term to describe autumn pastures on which hoggets do well. A browntop pasture, for example, will be shorter than typical mixed dairy farm pasture at the same stage of maturity. At present there is no accurate means of assessing the maturity of a pasture and its suitability for hoggets. The longer it is, the more certain its suitability, but it is clear from experience with dairy farm pastures that stemminess is not a criterion.

At the Ruakura Hill Station very good hoggets, entirely free of ill-thrift, have been reared each year on a 100 acre paddock spelled from early December. By the end of January the mixed pasture is long and much seed head is present. This paddock, set-stocked with hoggets at the rate of 1½ to 2 hoggets per acre, "gets away" at this light rate of stocking, but has carried the hoggets in good growing condition throughout the autumn and winter.

A long pasture which proves satisfactory for hoggets deteriorates from this point of view if the rate of stocking results in the pasture being controlled. This form of management requires a succession of spelled pastures and in a season such as the past one this is easy to provide. This year this system has given good results; the hoggets have been given the first pick of each of four spelled paddocks and have been followed by ewes which were successfully flushed on the

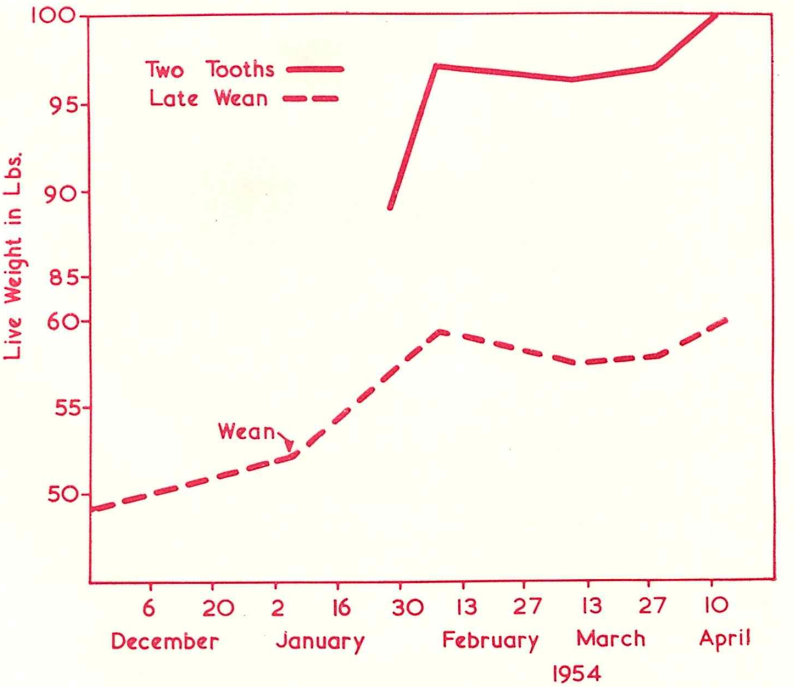


Fig. 4: Live-weight curve of hoggets and two-tooth wethers.

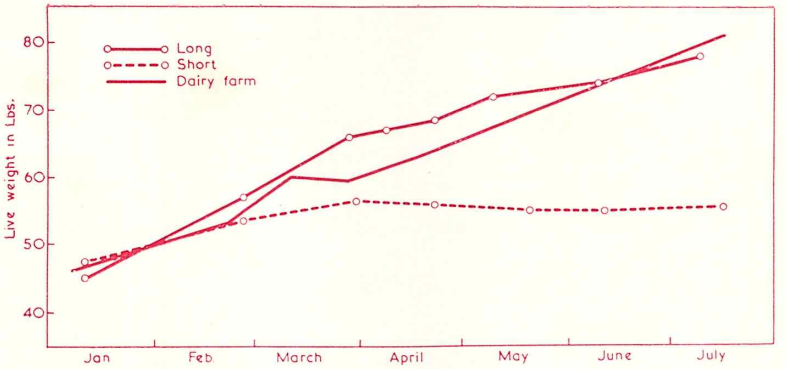


Fig. 5: Live-weight curve of hoggets grazed on a short pasture and a similar long pasture and a dairy farm long pasture.

remaining feed. The rate of stocking has averaged about four per acre. The length of time a paddock requires to be spelled to provide long feed varies from one to two months, according to growing conditions, fertility, etc. If, however, a paddock goes into a dry spell in a very bare condition, it may provide no suitable feed even after two months. Because of the frequent occurrence of a long summer and autumn dry spell in the South Auckland district, it has been found a wise precaution to spell pastures as early as possible for hogget rearing and, following a close grazing by sheep and cattle, some suitable paddocks are spelled from about mid-December onwards. The early weaning of lambs in late November or early December, by permitting greater flexibility in stock management, makes the early spelling of paddocks more practicable.

There are certainly some disadvantages and problems associated with the provision of long feed. On rough hill country which is being developed, spelling for long periods permits fern and weeds to raise their heads and slows the rate of progress. Insofar as fern control is concerned, this is mainly achieved in early summer. The autumn growth of fern is a comparatively minor problem and is readily dealt with the following winter. The flowering of ragwort is, in some areas, the most serious problem to be anticipated.

As far as the pastures are concerned, permitting some pastures to reseed each year is by no means detrimental and definitely encourages the spread of clovers and reduces the proportion of bare ground. Pastures which go into a dry spell with a good cover show subsequently a marked improvement over those in a bare condition through a dry summer and autumn.

Crops are a further safeguard against a shortage of suitable late autumn feed and have the further advantage of providing feed should precautions against facial eczema be necessary. Although hoggets may not always thrive well on crops early in the season, they come to little harm over short periods of a week or two.

Finally, attention might again be drawn to the excellent results achieved with hoggets on white clover (Fig. 8) both at Manutuke Station in Gisborne and in the last two seasons at the Ruakura Hill Station. Stocking rates have been as high as ten per acre for about six months at Manutuke where white clover swards can be maintained for up to four years. At the Hill Station, small areas of white clover have been readily established but tend to be badly invaded by grasses in the second year. Experience here has not gone beyond this second year. In certain areas of high fertility and in small pockets on farms, however, white clover might well prove to be a successful proposition and prove especially invaluable for "picking up" tail end hoggets.

In the absence of the right feed for hoggets, the only advice that can be given is to spread the hoggets as thinly as possible, watch for the secondary complications that can be treated, and hope for the best. There is no pill, drench, injection, or other direct action that is a substitute for, or palliative of, incorrect feed.

* * *

Summary:

(1) Hoggets are inherently hardy animals and their growth is directly related to the quantity and leafiness of the feed available except in the autumn and early winter months.

(2) During this period, a disease termed "hogget ill-thrift" may manifest itself.

(3) This disease varies in its intensity and incidence from year to year and from district to district.

(4) Its onset coincides with the fresh growth of pasture following the earlier autumn rains.

(5) Affected hoggets fail to grow or may lose weight severely. Post-mortem findings present a somewhat confused picture but in general are consistent with starvation. A high death rate may result.

(6) Its onset is rapid and soon gives rise to the paradox of starvation in the midst of apparent plenty.

(7) There are good grounds for believing that it is due to the nature of the short fresh feed on which intake is lowered. This latter finding could, however, be cause or effect.

(8) It seldom persists later than the end of June when the hoggets recover spontaneously and soon fatten in the same paddocks where they previously failed to thrive.

(9) This disease is not experienced on long mature feed, mature crops, or white clover swards.

(10) Early in the season, however, crops may be as unsatisfactory as young pasture and give rise to what is believed to be the same ill-thrift picture.

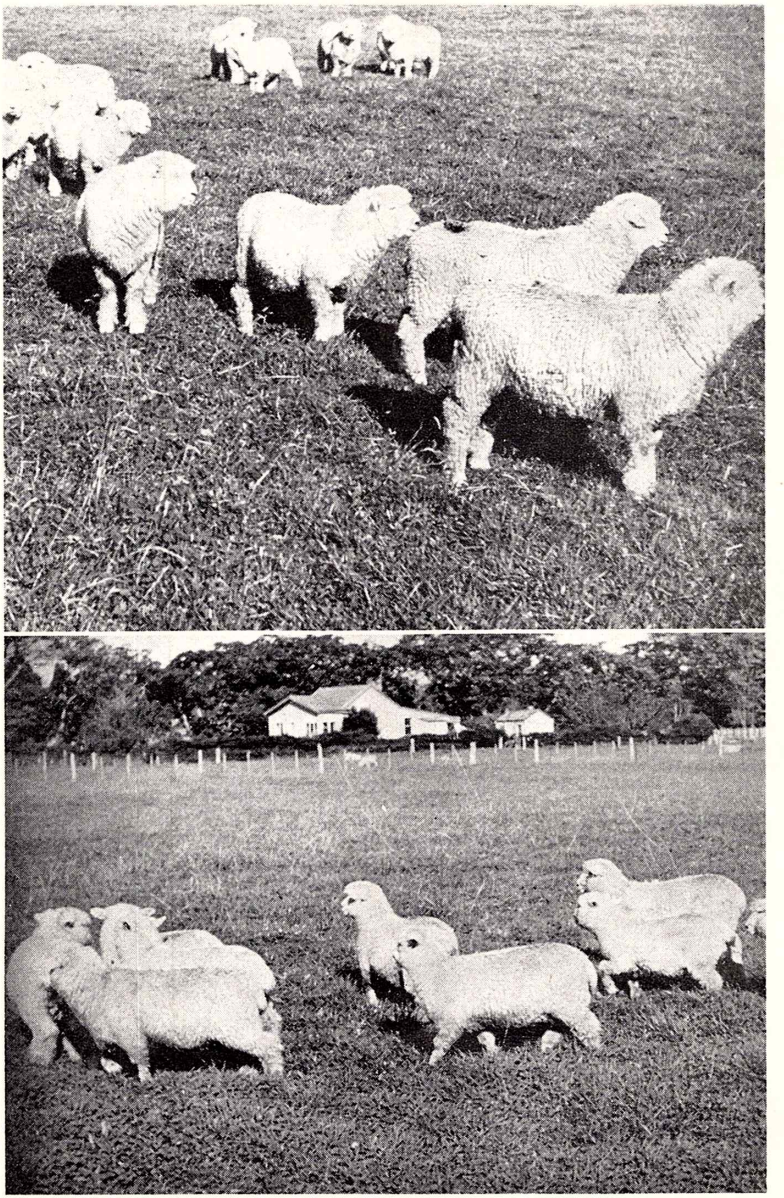


Fig. 6 (top): Typical short pasture—may produce ill-thrift in the autumn.

Fig. 7 (bottom): Similar pasture to Fig. 6 in a long condition (note stemminess in background)—usually gives better results with hoggets in the autumn.

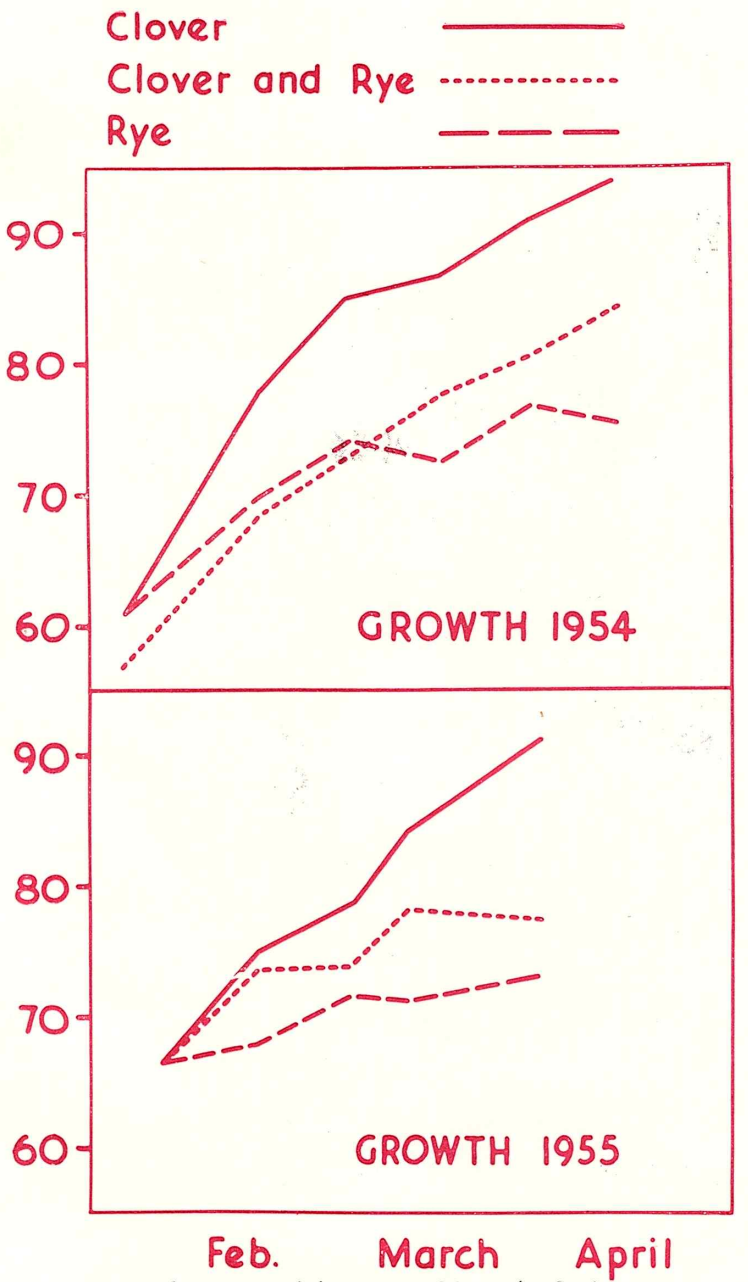


Fig. 8: Live-weight curves of hoggets at Manutuke Station on ryegrass pasture, on white clover pasture, and ryegrass-white clover pasture.

(11) The provision of adequate, long, mature feed is a management problem which becomes easier when early weaning is practised.

(12) Long, mature feed can be leafy and give almost maximum growth rate in hoggets.

(13) Even where the long feed has become stemmy, excellent results have been achieved.

(14) Where the rate of stocking results in the feed becoming controlled, the disease becomes manifest and a change in paddock is imperative. Where, however, the rate of stocking is low and the feed continues to "get away," hoggets may be safely "set-stocked" in the same paddock from January to July and later if necessary.

DISCUSSION

Q:: *Has Mr. Clarke had any experience of feeding peas to hoggets? I had three acres of peas last autumn and I put the tail-end hoggets on to them. In February we had rain and humid conditions and the peas sprouted. Hoggets do not like sprouted peas, so we stacked the rest of the peas and fed them out on the bare ground up to the beginning of May.*

A:: I have had no recent experience with feeding peas to hoggets. In the past, at Massey College, peas used to be fed to ram hoggets. It was found that the freshly sprouted peas were unpalatable to hoggets and that they did not do well on them. Peas which have been harvested and stacked are apparently relished by hoggets. We have not used them in the Waikato, as peas are a crop that does not do well there.

Q:: *Mr. Clarke mentioned thrift on white clover, but did not mention anything about red clover or Montgomery red, which are probably about the same as far as feeding value goes. Would Mr. Clarke recommend the use of more red clover, which, in my opinion, is a very valuable plant?*

A:: We have had very limited experience with red clover as we have never had a dominant red clover pasture with which to experiment. We have had temporary pastures which have become somewhat red clover dominant at times, but have not had any poor hoggets on those. We are certain of our ground as far as white clover is concerned, but I would not like to make such a definite claim in view of my limited experience with red clover.

Q:: *I have done everything "according to Hoyle," yet I lost a lot of hoggets. Admittedly the bulk of them had facial eczema, but is hay of any value in trying to stop the scouring and ill-thrift?*

A:: If you have had eczema I am afraid that long feed or any other sort of feed is not going to give good results. Occasionally we have found people not getting the results they expect on long feed. It is not a fattening feed but hoggets can be expected to grow on it, and to grow reasonably well. Where they do not do well on long feed we have generally found that it is for two reasons:

(1) The feed has not been particularly long and mature. It has been saved in the autumn, and saved in the quick growing period—say, shut up for a couple of weeks. We have seldom found that pasture saved for such a short time is very mature. The pasture that we find gives the best results is something that has been shut up before the dry spell, carried through the

dry spell, and then used when the hoggets start to go back; although it has got somewhat rough and stemmy by that time, there is still a high proportion of leaf present and the hoggets will do very well on it.
(2) We have found people using rank, stemmy pasture lacking in leafage which is often mouldy at the bottom. This type of pasture is not advocated. You will get caught out in a wet season and will get mould and sometimes a lot of rust in some of these long pastures. We have been reasonably successful in getting some pastures in good order by shutting up in late December after heavy stocking with sheep and cattle. As for feeding hay, we put out racks of hay to sheep on short pasture and to our surprise the sheep have taken practically none. Calves, on the other hand, suffering from a similar condition of ill-thrift, have eaten a certain amount of hay and have done quite well. It might be easier to persuade hoggets to eat hay if it were good quality lucerne hay.

Q:: *What is the effect of rust on hoggets?*
A:: It has long been believed that a rusty pasture will check hoggets very severely. We have had experience with rust in only two years, and in one of these years we were feeding ryecorn to hoggets. It was very badly rusted, the hoggets ate it right to the ground, and over the period they were grazing it they put on about 2½ lb. per week in weight. Last year we had another crop of ryecorn which was rusted and we did not seem to get a very satisfactory growth rate on the hoggets—in fact, most of them put on very little weight while they were on it. I do think the effect of rust has been a bit exaggerated. It does seem, however, that ryegrass which is badly rusted is more unpalatable to all stock than ryegrass which is not rusted.

Q:: *Would phenothiazine cause blindness in sheep, or would the blindness be attributable to pink eye?*
A:: Drenching sheep with phenothiazine will not cause blindness. For example, we drenched a mob of hoggets with phenothiazine at fortnightly intervals for three months, and over that time, grazing on long feed, they grew remarkably well. At the end of the period the drenched sheep were about 1 lb. heavier than the undrenched ones. However, precautions must be taken when drenching calves with phenothiazine. Blindness in sheep is generally due to pink eye.

Q:: *My hoggets were vaccinated against scabby mouth, which has been present in the past, but not this year. However, the hoggets this year were very unthrifty. I therefore called in the local veterinarian, who sent samples to Wallaceville. They said the unthrift was due to insufficient drenching. These sheep had been drenched three times with phenothiazine and once with N.C.A. at approximately three-weekly intervals. The suggestion was that I was not drenching early enough. Could you enlighten me on that point?*
A:: Actually it is very seldom necessary to drench hoggets before the first autumn rains. There may be rain soon after weaning, however, and an outbreak of haemonchosis may occur early on which will give a typical picture of anaemia, but that is generally a condition which responds very rapidly to drenching. *Haemonchus* is one parasite that does cause unthrift and which is cured by drenching. Later on, however, when hoggets get the typical ill-thrift condition, they become parasitized. The parasites produce a further effect on the sheep, usually a small effect, but a heavy infestation may result in some of those hoggets actually dying. Drenching will remove most of the parasites, but it will not necessarily cause the

hoggets to pick up, because the trouble is not due to the parasites, but rather to the ill-thrift condition, which is generally caused by short, immature feed. The only way that we know of bringing the hoggets through and causing them to grow again is to put them on dairy farm pastures, because of their maturity, or on crops which are mature, or on long grass, etc. Because the grass is long it is not necessarily mature—it may have been saved over a short period. We believe that it takes at least a month's shutting up, and sometimes more than that, for a pasture to become mature, particularly autumn-saved grass. The only way one can tell if it is really right or not is to try the hoggets on it. If it is right, they will respond immediately.

Q:: *Does choumoellier become mature in relation to the time it is sown, or in relation to the time of the year?*
A:: I do not know the real answer to that. With kale we have generally had very poor results feeding it in the autumn except some that was sown in September, which gave a reasonably good result. We usually sow it later than that—November—and get very poor results with it. The time of sowing might be a factor. In our district, results from feeding choumoellier in early February are usually indifferent. Fed at the end of March or early in April it generally gives us fairly good results. How one is to tell whether the crop is mature or not I am not sure. With a crop like rape it is fairly easy—there is purpling of the leaf, indicating maturity, and generally it is safe to use when that has occurred. If rape is used before that, the results are generally very poor.

Q:: *The crux of the matter seems to be to provide the right sort of mature feed. Mr. Clarke has told us that we should shut up our pastures about the beginning of December. Would he indicate what condition the pastures should be in when they are shut up at the beginning of December? I think that is very important, because we do know, from results over the years, that with certain classes of overgrown spring feed it is possible to have a high death-rate amongst hoggets. To cure this death-rate, many men have used cattle to control the growth.*
A:: The paddocks are chewed right out with cattle, or with ewes followed by cattle, in preparation for shutting up, which is done from December onwards. They are then allowed to come away for the rest of the growing season to provide a succession of saved fed. Normally we get a dry spell at the end of January and early February, and we keep some pastures as standing feed and use them when the hoggets start to do poorly on the short, leafy pasture. We have never attempted to shut up a paddock that has been carried through from the spring with any length on it, so do not know what sort of result we could expect from it. I should imagine that there would be a very rank bottom and a lot of mould in such a pasture which would not be very palatable.

Q:: *I should like to know whether you put any cattle in with these hoggets or not? I come from a district where we have a very high rainfall and the grass just bolts in January, and we sometimes get a lot of ill-thrift before the end of that month.*
A:: We have had best results where we have not run cattle with the hoggets. Where cattle are run with the hoggets they tend to control the pasture and it gets back to the short, leafy bite too quickly. We prefer to see the pasture uncontrolled by the hoggets, and, although we cannot say precisely how mature it should be or how one can judge its maturity, we generally find that the longer it has been shut up the more likely it is

to be safe, and, even though it is very stemmy, it is surprising how long the hoggets will keep going on it over the ill-thrift period.

Q:: *On a browntop pasture?*
A:: We have not anything that could be called a pure browntop pasture, but five or six years ago when our pastures were browntop dominant we got just as good results as we do today.

Q:: *Did you have any losses with the group that was drenched fairly frequently, even though they lost weight?*
A:: You must have misunderstood me. The group that we drenched frequently did not lose weight. At the end of three months, drenched fortnightly, they were slightly heavier than the control group and both groups grew remarkably well. There were no losses from drenching.

Q:: *Will drenching prevent deaths in unthrifty hoggets?*
A:: Yes, it will keep the parasite burdens low and prevent deaths due to heavy parasitism in an already weak animal. The parasites (not including *Haemonchus*) are, in such cases, the "last straw."

Q:: *Does Mr. Clark have any trouble with scald due to long pastures?*
A:: We have not had any trouble with scald. We keep the feet well trimmed. Occasionally the odd hogget may be found to be lame, and if it is not convenient to put the mob through a bluestone bath, the shepherd generally puts a bit of powdered bluestone between the toes and that seems to keep the situation in check.

Q:: *You are, of course, dealing primarily with hill lambs. Some of us living on the flats buy store sheep from the backcountry. Do you think that the change of environment has anything to do with the ill-thrift, or that bringing them on to the richer grass tends to make them scour?*
A:: The hoggets with which we have been experimenting have been reared both on hill country and at Ruakura. At Ruakura the pastures are capable of producing 300 lb. of butterfat to the acre, and that is where the more intensive studies have been carried out. The hoggets which we use are bred on the hill station. They are small hoggets—no more than 50 lb. live-weight at weaning in November, and quite small compared with the blackface hogget. They are brought down to Ruakura and they go ahead on the long dairy farm pastures, and also on the controlled short feed on the hogget area until the autumn check starts. Those on the dairy farms and those on the long pastures on the hogget area keep going, and those which are on short pasture check, with all the emaciation and scouring symptoms of ill-thrift developing. I do not think the change from hill country to the flats has anything to do with it.

Q:: *Would Mr. Clarke care to comment on the somewhat mysterious attacks of pleuro-pneumonia which occasionally are very serious? The disease occurred in the strong growing period in the early autumn about the end of March. This year I thought I would be shrewd and use the older, more mature pasture which had been shut up for weaner calves. Within a fortnight, on those more mature pastures, there was decided trouble with pleuro-pneumonia, or rather pneumonia, since I could not find any pleurisy in this case.*
A:: We have found pleuro-pneumonia quite commonly in hoggets. Shutting hoggets up is likely to spread that sort of infection. I think it is in the category of a secondary infection, as we have never had more than an odd case in hoggets which have been doing well. Our losses from pleuro-pneumonia have always been in groups that have not been doing

well because they have been on the wrong sort of feed. I know it is a disease where one can have very heavy losses. I should not think the long feed, in your case, had anything to do with it. I should think the complaint developed because the hoggets were not in particularly good condition when the infection was about.

Q:: *I should like to ask Mr Clarke if he has taken any account of the respective merits of shady and of sunny country?*
A:: Over the six years we have used both shady and sunny country. For preference I would back a sunny face, but I have no evidence that such would be better. There is one point I should like to mention, as perhaps I have not made it clear, and that is that this long feed gives good results, but if the rate of stocking is high I should not like to guarantee the results. We have achieved our results on hill country under reasonably low stocking rates. We have never exceeded about four hoggets to the acre, and have used four hoggets to the acre on a series of paddocks so that we have shifted the sheep round, leaving them three weeks or so in one paddock, then shifting them on and bringing the ewes in to the paddock just grazed by the hoggets. A succession of four paddocks used in this way has carried all the hoggets through the autumn at the rate of about four to the acre. Where we have set-stocked we have never exceeded about 2½ to the acre, so we still have a few things like that to find out. Where some people have not had the good results they expected from long feed, the stocking rate has probably been too high. If the scope of selective grazing for the hoggets is cut down a certain proportion of the pasture is brought under control—you will find patches eaten out—and results are not nearly so good as where the stocking rate is lower.

Q:: *I should like to ask Mr. Clarke if he thinks there is any merit in the idea of saving an untopdressed paddock on hill farms, the idea being to have some unimproved pasture to feed the hoggets during facial eczema outbreaks or other difficult periods?*
A:: Eczema has been known to occur on untopdressed pastures, and I should not like to guarantee that they would be "safe" from that point of view. We have been carrying out these hogget trials over six years, along with pasture improvement, by topdressing and oversowing. We are still getting as good results today from the paddocks that have, by this time, had up to ten hundredweight of super. to the acre as we did when we first started, when they had had only two hundredweight of super. to the acre. I do not think that topdressing has any effect on the hogget. We have had excellent results on Ruakura itself on pastures that have been topdressed for thirty or forty years at two hundredweight to the acre, provided the pasture was allowed to become mature. The pastures at Ruakura, with a fair amount of paspalum in them, had become very neglected-looking pastures, but the hoggets did well on them, and, although it looks like bad farming, I think that from the hogget point of view we might come to regard it as quite good farming.

Q:: *Are any stock licks beneficial to hoggets?*
A:: Where there is a known mineral deficiency, and the mineral deficiency areas are fairly well known, a lick can be expected to give fairly good results. In the cobalt-deficient areas, licks are no longer necessary where cobaltized super. is being used. In certain areas there is an iodine deficiency which can be corrected by iodized salt lick. Copper-deficient areas are known and topdressing with copper sulphate at the appropriate rate will correct that deficiency. We have tried supplements against all the common

deficiency diseases without success. We believe that the hogget ill-thrift is a starvation complaint and is due to lowered intake, but what is causing that low intake is the thing that is puzzling us at the moment.

Q:: *Some people feel that if hoggets are shorn in the autumn they thrive better. Has Mr. Clarke any evidence to support this theory?*

A:: Yes, we have tried shearing them and although everyone who has seen the hoggets has remarked on how much better the shorn ones were doing, the weighing scales have never told us that that was the case. Under our conditions shearing did not show any benefit, though I believe some people claim good results from it.

Q:: *Has any work been done on the rumen contents? Has any attempt been made to inoculate the rumen contents of hoggets on both long and short pasture? Further, because the work on facial eczema has been a prominent feature of Ruakura's investigations, has there been any attempt to relate facial eczema and hogget ill-thrift?*

A:: We have done a lot of work on the rumen content picture. Dr. Gall did some work on the rumen picture in our hoggets but without any clear-cut results. We have found differences between thrifty and unthrifty hoggets in the rumen contents from both the micro-organism and chemical points of view, but the results have not been consistent and I do not believe that that approach could get us very far, for the reason that hoggets respond so rapidly to these changed conditions. Furthermore, under pen-feeding conditions, where we can measure what is happening from day to day, we can switch a hogget from one type of feed to another, and get a response detectable in 24 hours. The change is too rapid for a maladjustment of the rumen flora to be the real cause, at least in my opinion. The big difference observed in the rumen analyses of thrifty and ill-thrifty hoggets is, I think, effect rather than cause. As far as similarity between eczema and hogget ill-thrift is concerned, we believe there is no similarity at all. The hogget ill-thrift is a condition which persists over a very long period—the grass is unsuitable for hoggets for three and sometimes four months. It varies, certainly from year to year, but we find no trace of liver lesions, though we have looked for them very carefully.

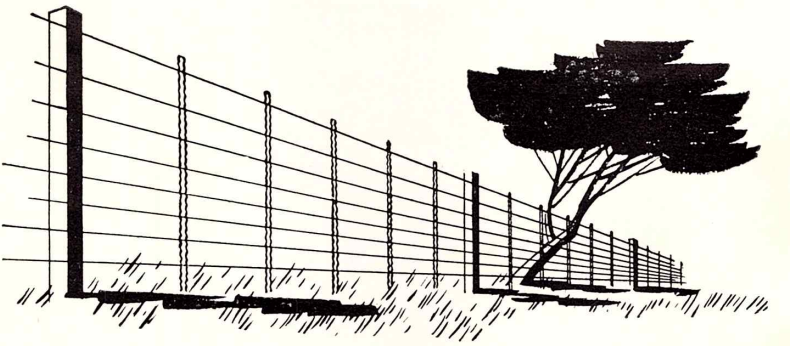
Q:: *Years ago we did not hear any talk of this hogget ill-thrift. Would Mr. Clarke tell us if hogget ill-thrift is something new, or is it just something we did not recognize as ill-thrift years ago?*

A:: I remember when I was a student, Lincoln and Lincoln Cross sheep were still being used on some of the hill country in the North Island. These sheep were going out of favour because of the difficulty of rearing hoggets, and the symptoms that I have heard described then are strikingly similar to the symptoms described in the present-day hogget ill-thrift. I do not think it is a new problem by any means. Some members of the audience may have more information on that.

A MEMBER:: One used to budget for a 25 per cent. death-rate.

Q:: *Is it possible that calciferol might be a good thing to use during the dry weather under New Zealand conditions?*

A:: Calciferol is useful only to cure rickets, and so far as New Zealand is concerned we get rickets in midwinter—June onwards. If the hoggets have got rickets, calciferol will give marvellous results. If there is no rickets, it will not do one bit of good. We have tried it on two-tooth ewes, on older sheep, and on hoggets, and we have never had any response from it at all except with hoggets suffering from rickets. Furthermore, under drought conditions, the feed is rich in vitamin D, which is what the calciferol supplies.

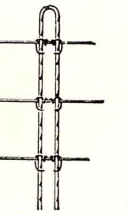


Fence to last with non-slip, non-split, easy-to-handle

Bull-Dog Tight Grip

Fencing Battens

Light weight (50 battens weigh only 39 lbs!), yet extremely strong. Low initial cost. Heavily galvanised, requiring no maintenance. Simple to attach with the ingenious non-slip clips provided. Fit any fence whether plain or barbed wire. Particularly suitable for dropping by aircraft on difficult hill country. Normal length 3 ft. 10 in., but can be supplied in shorter lengths if specially ordered. These neat, efficient battens are ideal for both sheep and cattle fences and for attractive fences around homestead or city properties.



Distributed by

SUMMIT PRODUCTS LIMITED

SUMMIT PRODUCTS LTD.
P.O Box 328, Palmerston North.

Please send me illustrated folder and price list for Bull-Dog Tight Grip Fencing Battens.

Post this coupon Today!

NAME .....

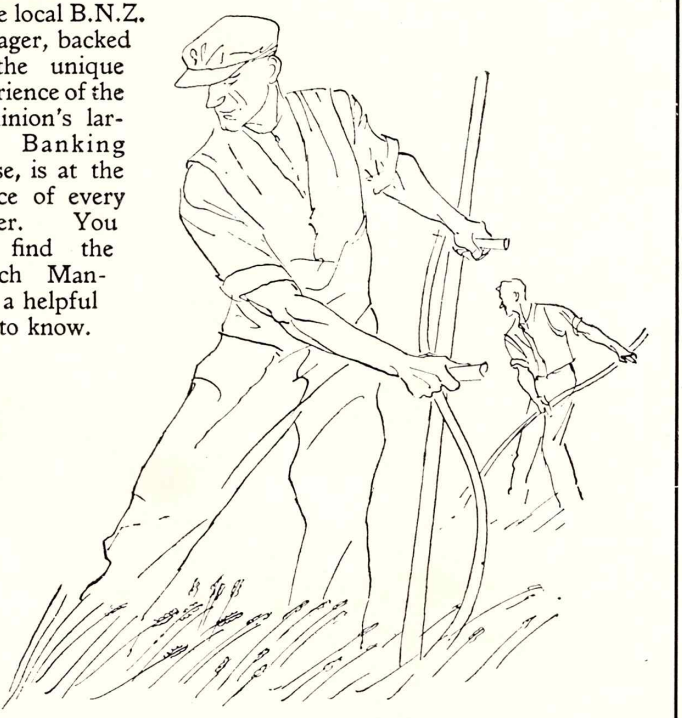
ADDRESS .....

.....

For every job . . . today . . .

there's a better way

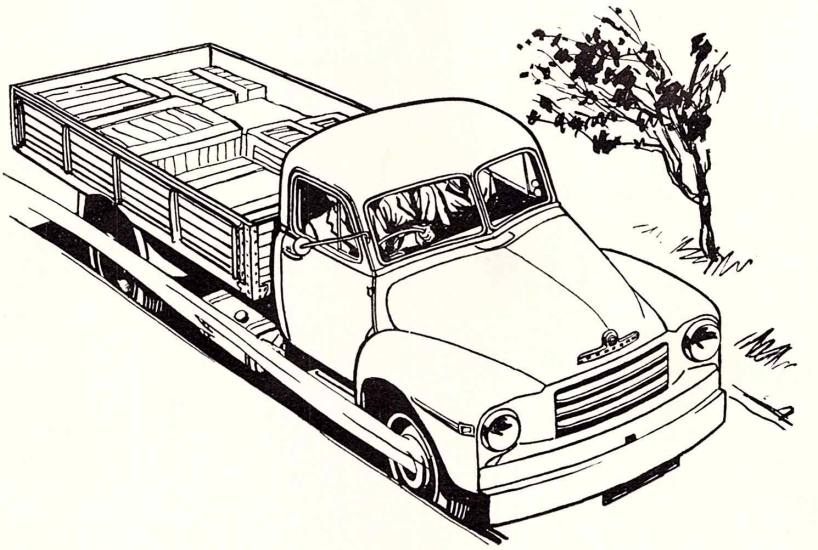
Just as modern farm machinery has taken most of the drudgery out of farming, so have the services of modern banking helped to relieve the farmer of his financial worries. The friendly advice in financial matters of the local B.N.Z. Manager, backed by the unique experience of the Dominion's largest Banking House, is at the service of every farmer. You will find the Branch Manager a helpful man to know.



BANK OF NEW ZEALAND

The Dominion's Largest Banking House

Over 350 Branches and Agencies in New Zealand to serve you



On the Farm . . .

On the Road . . .

Depend on

BEDFORD

to carry the Load

Models from 10 cwt. to 10 tons

Distributed by

GENERAL MOTORS NEW ZEALAND LIMITED

through a New Zealand wide network of Authorized Dealers

What will it carry . . .

. . . mortgage - or money in the bank?

The key to successful farming lies in estimating accurately the stock a pasture can carry, thus enabling the farmer to work his land to capacity. But pasture cannot yield maximum results while gorse, ragwort, rushes and weeds are allowed to dominate productive grass and clover. "Plant Protection" weed-killers have been specially formulated to rid farms of the menace of costly weeds, turning mortgages to money in the bank.

"AGROXONE" M C P

"BUTOXONE" 2.4.5-T

"ETHONE" 2.4-D

"FRENOKONE" Sodium Salt of 2.4-D

Available from your local "Plant Protection" distributor

The Science of Plant Protection

IMPERIAL CHEMICAL INDUSTRIES (N.Z.) LTD.

SOME ASPECTS OF THE NEW ZEALAND WOOL BOARD'S POLICY ON THE DEVELOPMENT AND PROMOTION OF THE INDUSTRY

H. J. WARDELL*

MORE THAN ELEVEN YEARS HAVE PASSED since the New Zealand Wool Board was set up under the Wool Industry Act, 1944, and it is timely to consider the progress the Board has made in discharging its mandate under the terms of that statute.

The Wool Industry Act, 1944, charges the Wool Board with the following functions:

¶ To promote the use of New Zealand wool in existing or in new markets, by such methods of publicity or other means as commend themselves to the Board.

¶ To promote, by way of subsidy or otherwise, scientific and industrial researches in relation to wool and sheep, with a view to the improvement of the quality of New Zealand wool, or the increased production thereof, or improved methods of utilizing it, or generally in connection with the wool production industry.

¶ To act in combination or association with any body having similar functions, whether established in any other part of Her Majesty's Dominions or elsewhere, on terms of sharing the costs and expenses involved in that association in such proportion or in such manner as may be mutually agreed upon.

¶ To exercise such functions in relation to the production, handling, pooling, appraising, storage, distribution, marketing, and disposal of wool as may be conferred on the Board by the Act or regulations made under the Act.

¶ To advise the Government in relation to all or any of the foregoing matters.

The establishment of the New Zealand Wool Board followed a pattern laid down in South Africa, and to a lesser extent in Australia. (The activities of the Australian Board are confined, in the main, to straight-out wool promotion.)

Since 1937 the New Zealand wool-growing industry has been closely associated with the wool boards in South Africa and Australia through the International Wool Secretariat, but our representation on that body was, before the 1944 Act, through the organization known as the New Zealand Wool Council. The New Zealand Wool Board, therefore, is not only the youngest of the main primary producer boards in New Zealand, but it is also the most recently formed of the three Dominion wool boards.

It will be seen that, though the functions of the Board are wide and comprehensive, emphasis is laid on:

(1) Promotion of wool in existing and new markets.

**Deputy Chairman, N.Z. Wool Board, Wellington.*

(2) Associating with any other body having similar functions.
(3) Exercising the functions of marketing and disposal of wool conferred on the Board by the Act or by regulations under the Act.

It is these three functions that will be discussed in this paper.

Promotion of Wool

Before the war, the consumer had the choice of three main fibres —cotton, wool, and silk. Such competition as existed between these material fibres was well-known and acknowledged. The consumer knew and appreciated the merits and behaviour of each fibre and was not then, as now, exposed to conflicting promotional and advertising claims.

In the late thirties, the first of the man-made fibres, rayon, appeared on the textile market. The development of these fibres was not in response to a commercial demand for a cheaper fibre but was, in the main, sponsored by the Axis powers, who were preparing for a war during which they knew raw wool would be in demand. Thus, when war broke out, 80 per cent. of all rayon was being produced in Germany, Italy, and Japan; after the war, however, with the reduced production of silk and the increases in price of the other natural fibres, rayon production was stimulated—this time by a commercial demand for an alternative fibre.

In the post-war era, because of impressive technological advances in fibre research, principally in the United States, many new synthetic fibres forced their way on to the world's textile markets. These new synthetics, which are of chemical origin, are supported by enormous production and research budgets, and although their ultimate end-uses have not yet been finally determined, their appearance in fabrics, which were formerly made from natural fibres, is causing confusion in the mind of consumers to the point that they are allowing themselves to become willing guinea-pigs. Consumers are accepting promotional promises as guarantees, and are market testing these new products, often with substantial monetary losses. At the moment the spearhead of this promotion is in the U.S.A., but its influence is rapidly spreading to other important consumer countries.

Although the position of wool in the outerwear market has not yet been seriously challenged by any of the known synthetics used by themselves, mixtures of synthetics with wool constitute a definite threat to pure wool fabrics. The expenditure in research on these fabrics indicates that the sponsors are working assiduously towards a product that, to use their own phrase, will become "woollier than wool."

Propaganda, if skilfully used, can play a very important part in swaying public opinion. In the U.S.A. it has been proved that, by the very weight of publicity, you can sell an inferior article against a superior article which is less favourably promoted.

The challenge of synthetics can best be demonstrated by the advertising and research budgets made available for their promotion.

In the U.S.A. alone this year $10 1/3 million will be spent to induce the consumer to use fibres other than wool, as against $1 1/4 million spent trying to persuade the consumer to use wool. This is a ratio of 8 to 1. Of the money available for synthetics, one large chemical concern alone is spending nearly $7 million on advertising and promoting its fibre.

So far as research in the U.S.A. is concerned, this year man-made fibre interests will spend some $50 million, while cotton research will absorb $14 million. The budget for wool research will be round $1 million. This indicates the problem facing wool producers in the three wool-growing dominions. Growers must recognize that the advent of synthetic fibres has had a very important impact, not only on fabrics, but also on design and consumer appeal.

It is, therefore, important that growers appreciate that this is not only their problem but also their responsibility. Speaking generally, manufacturers are not greatly concerned with the origin of the fibre they use, whether it is a natural fibre or a man-made fibre. All they are concerned with is the production of a material that has consumer appeal, and that can be sold at a price which will show them a reasonable profit.

Gone are the days when a grower can put his wool into a sale and forget all about it as soon as he receives his cheque. His cheque will be much smaller unless he accepts the responsibility of following his product to the manufacturer, to the retail counter, and to the consumer. He must substantiate his claim to the consumer that "there is no substitute for wool." He must take an active part in research, and accept the very important responsibility of taking the results of research to the manufacturer in a form he can understand and apply.

His mouthpiece to the great consuming countries on the other side of the world is through the International Wool Secretariat and it is against this background, with its conflicting advertising and its clamour for consumer attention, that world wool publicity and promotion must be conducted.

International Wool Secretariat

It was, indeed, opportune that the Inter-Dominion Conference of wool producers that took place in Melbourne in 1937 had the foresight to set up an organization, with its headquarters in London, to be known as the International Wool Secretariat, whose function was world promotion of wool through publicity and research.

The Secretariat's activities began in 1938 on a modest budget of £12,000, which in the following year was raised to £63,000. Activities during the war, although very limited, were maintained by a skeleton staff, the annual expenditure being reduced to some £16,000. With the end of the war in 1945 the wool boards began to develop the scope of the Secretariat's international activities so that in 1946 the annual expenditure was up to £71,000. From then on the influence of the Secretariat was gradually extended until in 1955 it had offices

and representatives in 14 different countries with an annual expenditure of just over £1 million.

The budget for this year is expected to be £1¼ million, to which must be added the contributions received from the wool manufacturing industry in Europe and America, amounting to more than £310,000.

This contribution from manufacturers is becoming increasingly important to wool-growers since it is a trend that should give them increasing support in the work that is ahead. It is also proof of the growing confidence of the trade in the aims of the Secretariat and of its ability to carry out widespread and efficient wool promotion.

The reputation of the Secretariat stands high today but it has taken many years to build up the reputation it now enjoys. This steady development of joint wool promotion projects with various sections of the trade has grown from a modest beginning in 1952—the first contribution, amounting to £18,000, came from the wool industries in Germany and France. Today it is a major feature of our activities.

It is perhaps not too much to hope that, with skilled liaison, manufacturers may be prepared to go 50/50 with us in joint wool publicity and promotion. In this connection it is worth noting that in countries such as Denmark, Norway, and Sweden, contributions from the trade actually exceed the budget allocation made to them by the Secretariat.

Each year the Board sends representatives to the executive meeting in London and to the board meeting of the Wool Bureau in New York, where plans and the budget for the following year are thrashed out and finalized.

As mentioned, last year the Secretariat's budget, excluding contributions made by the trade, amounted to just over £1 million. The New Zealand Wool Board's contribution to these funds was £248,000, out of the Board's total revenue of £316,000. Wool-growers will thus appreciate the importance the Board places on the work and, from what has been said, the need for further expansion, so that we can insure a place in the sun for our product.

The Effect of Hire Purchase

Since the war there has emerged another factor that is having an important influence on the consumption of apparel fibres. This is the declining share of goods made from these fibres in the disposal of consumer income, owing to the appeal of hire purchase.

Durable goods encouraged by this system of financing are claiming more and more attention from the consumer, and all apparel fibres are feeling the chilly draught of this competition. Textiles are thus in marked contrast to steel which is booming, with consumption running ahead of supply.

In the U.S.A., which is the home of consumer credit, the following figures may be of interest. In 1946 the amount invested in hire purchase was $4 billion; 1948, $11 billion; and 1955, $23 billion.

In 1955 the total consumer savings and investments were $19 billion, so that hire purchase claimed $4 billion more than savings and investments. Immediately after the war, clothing expenditure amounted to about 10 per cent. of the disposal consumer incomes. In 1955 it had fallen to just over 6 per cent.

The new generation is demanding and receiving more and more leisure, but the great trouble about leisure is that it can be so very expensive. This new generation is showing unmistakably that it prefers to spend its spare cash on things other than clothing. The old insistence on quality plus durability has, it would appear, gone, unless it can be recaptured through more intensified promotion. The danger thus inherent is that sooner or later the old skills may be lost simply because nobody is prepared to pay for them.

In May, 1955, with the chairman of the N.Z. Wool Board, I represented the Board at the executive meeting in London and the Bureau meeting in New York. From what I saw I am fully satisfied that the Secretariat is making our £1 go a good deal further in wool promotion than is possible in other, similar, promotion. I was also greatly encouraged by the advances made in research at Leeds University and to a less extent at the Textile Research Institute, Princeton University, U.S.A., and the very important work being carried out by Dr Carter and Dr Laxer in their liaison work between the research worker and the mills.

Work of the Wool Commission

The other matter in which the Board is closely involved, which is of very great importance and which I believe is not sufficiently appreciated by growers, is the work of the Wool Commission.

Wool-growers are familiar with the history of the Joint Organization and how that organization was set up to take over the disposal of the accumulation of 10½ million bales of surplus wartime wools and, at the same time, protect the growers' current clip through a floor price plan. The operations of J.O. were so completely successful that these surplus wools were disposed of in half the time estimated by the experts at the 1945 conference in London and undoubtedly saved growers from what happened after the first World War when, after a steep rise, prices fell to a completely uneconomic level. The Wool Board was so impressed with the success of this operation that, when the post-J.O. plan discussed at the 1950 conference in London was finally rejected by Australia, it asked the Government for legislation to set up an organization in New Zealand using the profits accruing from J.O. to finance the scheme.

The Wool Commission Act was passed in 1951 and provided for a scheme of floor prices for wool. The Act provides that the Wool Commission shall consist of six members, of whom two members—one of whom will be a chairman—shall be appointed after consultation with the Wool Board. Three members, being members of the

Wool Board, shall be appointed by the Wool Board and one member shall be appointed as an associate member on the recommendation of the Wool Brokers' Association.

Before the commenceent of the wool selling season, the Commission prepares a table of floor prices for all types of wool to be sold in New Zealand or, in the United Kingdom, at auction sales approved by the Commission. In deciding the level of floor prices the Commission is required to have regard to current trends and prospects in international markets, the amount of available finance, the views of the New Zealand Wool Board, the maintenance of production of wool in New Zealand, and such other matters as the Commission deems relevant. The agreement of the Minister of Agriculture is required for putting the table of floor prices into effect.

It has been always recognized that the floor price scheme is an underwriting scheme—premiums paid—which protects growers when prices are low, with a floor price at a level which will keep the industry afloat and functioning.

The scheme commenced with a floor price of an overall average figure of 24d. for greasy wool ex-store in New Zealand. It has since risen by stages until this season it stood at 30d.

Towards the end of the 1952 season there was a substantial drop in wool prices owing to consumer resistance to high prices caused by the 1951 boom, and the value of the Commission was amply demonstrated when, in the last round of South Island sales, it bought in over 1,700 bales. This had the effect of stabilizing prices and very little buying was necessary in the remaining North Island round. The value of the Commission is not the amount of wool it buys at auction, but the amount of wool it compels the trade to buy over and above the floor price in order to secure its requirements at that time. Trade opinion, as expressed in the Bradford *Wool Record,* declared that the presence of the Commission "and the fact that they [the Commission] were apparently ready to buy in wool themselves did however prevent—or at least helped to prevent—a wholesale collapse of the market."

Again this season, though the market was running well above the floor price, the Commission was called on to bid on isolated occasions, thus forcing buyers to raise their bid if they wished to secure that particular lot. There is no question that the presence of the Commission has an important influence on the prices paid at our auctions. Without attemping to bolster prices to artificial levels, it can exert a steadying influence at a time when the market is inclined to be irregular and uncertain.

Because of favourable seasons and the substantial increase in production of fine wools in Australia and South Africa, resulting in the production of these wools running a little ahead of demand, fine-wool growers have experienced a lean time over the last two years.

In Australia, when 76 per cent. of the clip is 60's and over, the fall in the average price has been 20¾d. per lb., as compared with 4d. over the same period in New Zealand where 67 per cent. of the clip is 50's and below.

The Bradford *Wool Record,* dated January 12, 1956, under the heading, "Uneasy Times for Wool Growers," has this to say:

> "The second half of the wool-selling season has opened with firm conditions in world markets. But the producers of Australia and South Africa are not at all happy about the price they are receiving for their clips, and there is more talk of price stabilisation schemes than at any time since Australia threw out the post-Joint Organisation plan in 1951. Of course, the growers are faring much worse now than they were then, when the world was using wool more swiftly than it could be produced, the auction system was giving the grower the best possible price, and the threat from synthetics had scarcely materialized. How different is the situation today. Australia is selling more wool than ever but getting less for it. The growers are left with high production costs from the boom period and are said to be on the 'bread-and-butter level.' Some of them are grousing about the auction system and there is even the suggestion that wool should be sold by private contract over long periods. The growers are faced with increasing price competition from the new man-made fibres, which, we may be sure, will seek to secure a price advantage over wool. Yet only New Zealand has a price-support scheme to help its growers in time of need. The producers of Australia and South Africa preferred not to put anything by for the future. The choice was only their concern, but, if it is proving an unwise one, nothing will be gained by trying to pin the blame on the auction system, which has given them golden dividends since 1946."

* * *

Two of the major activities of the New Zealand Wool Board which have engaged our attention over the last few years have been discussed. The Board has been represented at the two U.K. Government-Dominions' Conferences in London—in 1945 and again in 1950. The close co-operation with the sister Wool Boards in Australia and South Africa has been maintained in an endeavour to protect and expand our markets for wool overseas. At the same time, through the Wool Commission, we are protecting the growers' interests at auctions in New Zealand and in the United Kingdom.

The sheep is the most important animal in this country and the Board is not unmindful of the work claiming attention in New Zealand. To this end we are training scientists by granting bursaries and fellowships. We are co-operating with the other boards in training veterinarians and supporting the work of the Gisborne Veterinary Club. We are supporting the agricultural colleges in projects on sheep and wool, and through the Woollen Mills' Research Association we are seeking to institute research from the sheep's back to the finished fabrics.

DISCUSSION

Q:: *Nylon was used in the Polar expedition and evidently gave satisfaction. Nylon, especially for socks, gives better results than wool.*

A:: We do know that the manufacturers of synthetics were very anxious to make a contribution to the Polar expedition, because of the advertising and the promotional value that it would provide. There is no question that, from a strength point of view, nylon has very considerable properties that wool does not possess. Nylon has not, however—and no fibre yet has been produced that has—all the properties of wool. I know of men who cannot wear nylon socks. We do know that the American Army went into the war using cotton socks, and that they just could not stand up to it. Eventually they had to appeal to the British authorities to give them the non-shrink processes that were then being developed at Leeds, in order to get the American Army back into socks of wool. This introduced wool to many Americans who had not known it before. My reply to your question is that nylon would have its uses in the Arctic for strength, but I do suggest that, between the nylon and the wearer, wool should be interposed, because of its very important properties of warmth and absorption of moisture.

Q:: *Why are the wool interests not producing a non-creasing material?*

A:: I suggest that it is possible to produce a non-creasing woollen material. I think it depends a great deal on the spinning of the yarn. When I was in the United States last year we were told by the retailers that in their opinion the 2-ply summer suitings gave the best results from a non-creasing point of view. They said that if, after wear, a suit was hung up, in two days or so it regained its normal shape in a way that was not possible at all with synthetic suitings. All manufacturers may not be using it, but it is possible to produce a very satisfactory non-creasing material in wool.

One has only to travel on the planes in America to appreciate that. If you spend all night in the seat of a plane, and watch the people the next morning getting up out of their seats, you can pick the difference between a synthetic and a woollen suit.

Q:: *What will be the effect of bi-annual shearing on the future of wool and wool prices?*

A:: Bi-annual shearing produces the shorter staple wools which are suitable only for the woollen section of the trade. These wools are not suitable for worsteds. I would suggest that anyone who shears twice a year, unless he has very good reason to do this, will limit the market for his wool. He is getting competition only from the woollen section of the trade. We have had buyers expressing some concern that, because of the extra shearing, especially where growers take another fleece off before putting sheep into the works, they are not getting the combing wools that they were entitled to expect in the past. I would suggest that, from a wool point of view, from the market point of view, and from the return, a grower is not well advised to shear twice a year.

Q:: *Are paper felts being affected by competition from synthetic fibres?*

A:: As far as I know, synthetic fibres are not suitable for paper felts. The very high price that paper felts are receiving today result from the fact that they are becoming scarcer, and I do not think the trade has any substitute for wool paper felts.

VITAMIN A

— essential to sheep for . . . .

TOP CONDITION AND 'BLOOM', STRONG, VIRILE LAMBS, AND MAXIMUM FERTILITY

Until recently sheep depended entirely upon green pastures for vitamin A which is essential in adequate amounts for good condition and "bloom". Large losses and economic setbacks were suffered when climatic conditions rendered pastures a poor or totally deficient source of this important vitamin. Now, by using High Potency "VETEMUL" to supply vitamin A to sheep, the serious consequences of vitamin A deficiency that were accepted as unavoidable can be prevented.

HIGH POTENCY

'Vetemul'

TRADE MARK

High Potency "VETEMUL" is a concentrated veterinary emulsion supplying 25,000 units vitamin A and 2,500 units vitamin D per gramme. High Potency "VETEMUL" is specially designed to give an easy and accurate method of vitamin A dosing. High Potency "VETEMUL" may be given readily in a normal drench gun such as is used for phenothiazine. High Potency "VETEMUL" is a most convenient form of vitamin A supplementation as one dose provides full vitamin A requirements for three months following onset of dry summer conditions.

One gallon of High Potency "VETEMUL" (£11/10/-) is sufficient for one dose each to 220 sheep (rams, ewes or hoggets) or 320 lambs—only 1/- each for sheep and 7d. each for lambs. Each dose of High Potency "VETEMUL" for adult sheep, containing 500,000 international units of vitamin A, supplies full requirements for three months.

If you have difficulty in obtaining supplies or require further information, write to:

NICHOLAS PRODUCTS LIMITED, Marion St., Wellington

G8357

New Zealand's choice is

DAVID BROWN

"Pulling a heavy swamp plough, turning 24" x 10" furrow through heavy clay soil, covered with gorse, blackberry and manuka, *fuel consumption was under 1¼ gallons per hour*, which was amazing under the rough conditions."

K. M. F., Wanganui.

"The ability to haul logs of up to 1,000 super ft. content with the tractor and over double that with the winch, makes her the best hauling unit for the weight we have seen."

H. Bird and J. Nuku, Te Whaiti.

"The David Brown pulls a semi-swamp plough, 8-ft. tandem discs, 15-tine cultivator and all other general farm machinery. In 4 years, tracks have given no trouble, pins and bushes never turned and motor is original, only having had one valve grind."

Harry Short, Invercargill-Waikawa R.D.

CRAWLER & WHEEL MODELS, PETROL & DIESEL ENGINES.

FULL RANGE OF MATCHED IMPLEMENTS.

VERY LOW INTEREST TERMS AVAILABLE

N.Z. Distributors:
TODD BROS. LTD., Wellington
Dealers Everywhere

Todd Bros. Ltd., Box 2295, Wellington.
Please send me details of David Brown Tractors.

NAME .....

ADDRESS .....

..... S.F.A.

TEXTILE RESEARCH
and
THE NEW ZEALAND WOOL INDUSTRY

F. R. CALLAGHAN*

Introduction

THERE ARE TWO MAIN CHALLENGES facing wool-growers in all parts of the world at present. The first is the provision of sufficient wool of the right quality at a satisfactory price to meet the needs of a rapidly expanding world population, and the second arises from the development of synthetic fibres, the production and use of which have advanced markedly in recent years.

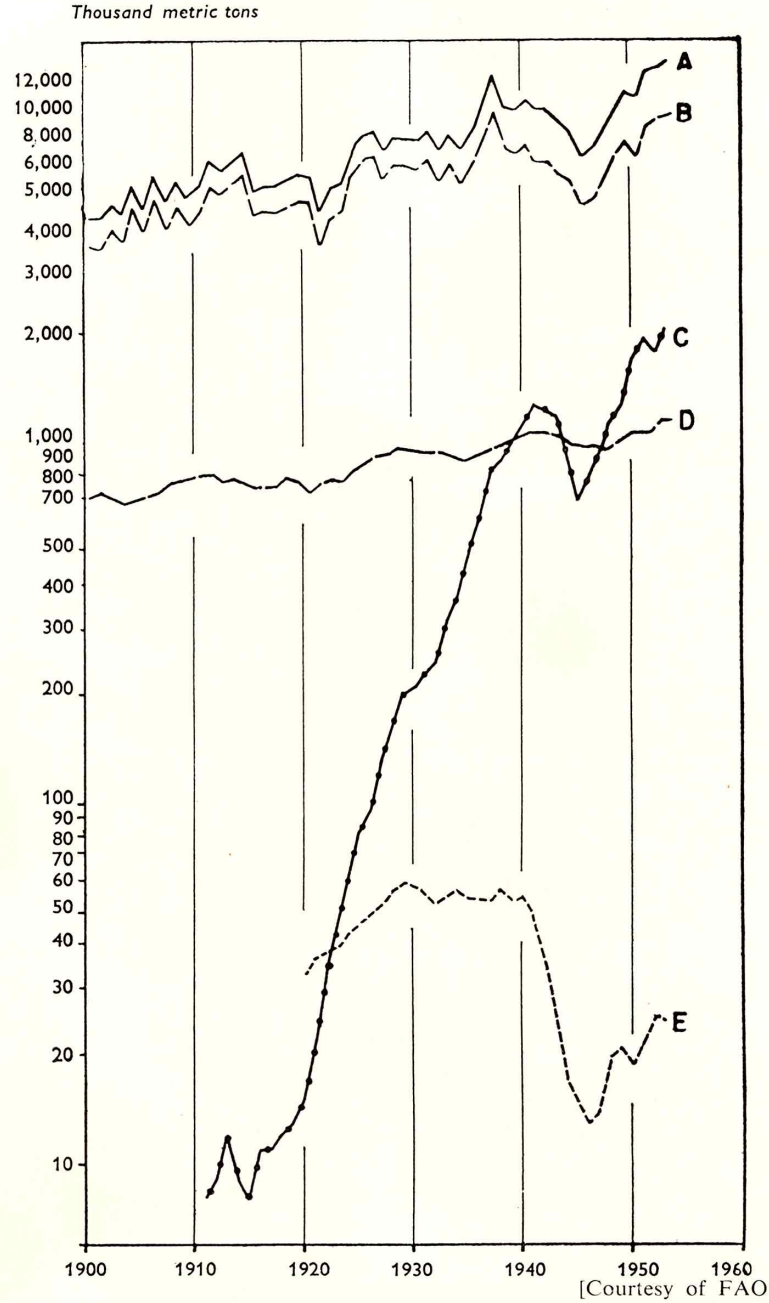
Insofar as research is concerned, the first challenge can be met by studies concerned with the breeding, nutrition, and diseases of sheep followed by such progress on the farm as will apply advantageous new knowledge to sound practices of sheep management. Judged by the increase in sheep population in recent years and by increases in wool production, New Zealand wool-growers appear to be certainly doing their share in this effort. So are Australian and Uruguayan farmers, but elsewhere in the world a static position exists, and in some countries production is falling. In the face of an increasing population, this state of affairs will result in higher prices and a search for alternative products. Today these alternatives are the man-made fibres, both the natural and the true synthetics, the products of chemical research almost all done during the past forty years. Today the production and consumption of synthetics exceed those of the age-old wool industry.

When it is considered that man-made fibres result from the efforts of chemists working in their laboratories, mainly on the difficult and complex problems of molecular chemistry, it seems obvious that the wool industry can ill afford to neglect scientific research if this formidable challenge is to be met.

It is only recently that science has been called in to deal with the problems of the wool industry. Britain pioneered this work at Leeds University and Torridon, but these have been dealing with wool problems for barely forty years, and, despite the efforts of chemists, physicists, and engineers, the chemical and physical properties of wool are so complex that they are yet far from being understood.

New Zealand's wool manufacturing is on a small scale, using only about 3 per cent. of our total clip. The remainder is exported, principally to the United Kingdom. The people of the world are the consumers of our produce and bearing in mind the old adage that

**Scientific Advisory Officer, N.Z. Wool Board, Wellington.*



[Courtesy of FAO

World production of apparel fibres, 1900-1954. A, total; B, cotton; C, man-made; D, wool; E, silk.

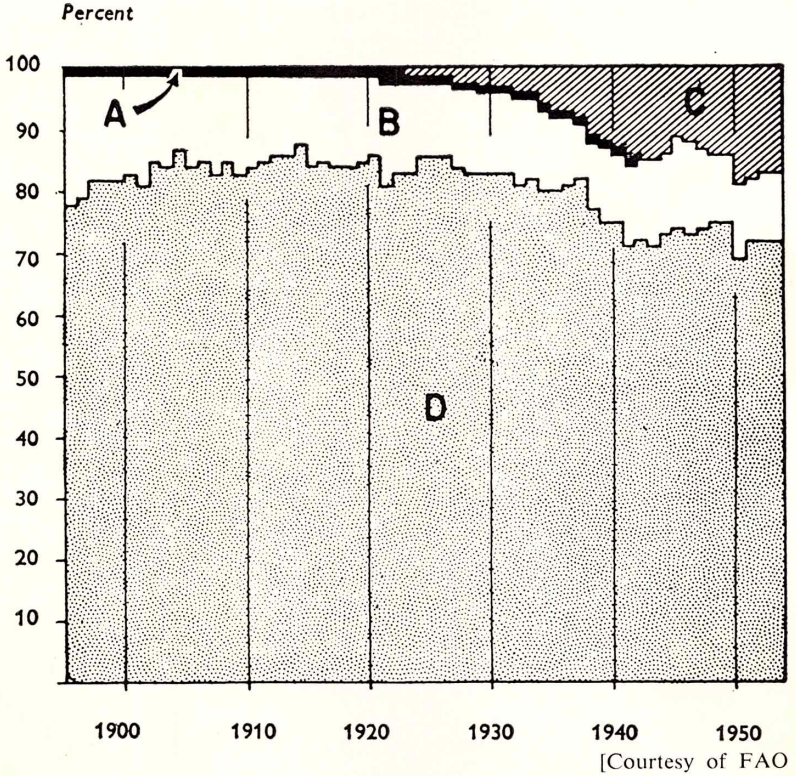
the "customer is always right," it behoves the New Zealand wool-grower to take considerable interest in what happens to his clip after it leaves the farm.

Some Statistics Concerning Apparel Fibres

In 1910, the first of the man-made fibres, rayon, entered the world's textile markets. At that time, 4 million tons of cotton, 790 thousand tons of wool, and 30 thousand tons of silk were being produced in comparison with 5 thousand tons of rayon.

In 1954, the corresponding figures were cotton 7,990, wool 1,140, silk 25, man-made fibres, 2,054 thousand tons. In percentage figures, cotton today is providing some 71 per cent., wool 10 per cent., silk less than 1 per cent., and man-made fibres 18 per cent. of the world's requirements of apparel fibres.

The percentage increase for cotton since 1910 is just under 100 per cent., for wool 70 per cent., for silk a decrease of 17 per cent., whereas the increase for man-made fabrics is over 400 per cent.



[Courtesy of FAO

World production of apparel fibres, expresed as percentages. A, silk; B, wool; C, man-made; D, cotton.

In man-made fibres, over 90 per cent. of the production falls into the rayon group. The true synthetics are very recent comers into this field being listed first in 1940, but in the fifteen years which have elapsed since that date their production has shown a rapid increase of 850 per cent., though in total their quantity is about 10 per cent. of all man-made fibres.

Though originally intended to replace silk, the man-made fibres have since challenged, in succession, cotton and fine wool. In view of the determined efforts now being made, this challenge will undoubtedly extend still more, and New Zealand as a crossbred-wool producing country cannot remain indifferent.

Since 1948, the trends in consumption of apparel fibres indicate a fall in natural fibres from 87 to 80 per cent. in 1953, while man-made fibres increased from 13 to 20 per cent. in the same period. The figures for wool dropped from 14 to 11 per cent.

Textile Research in New Zealand

In this article, textile research will be interpreted in a very liberal way and will make reference to all types of research dealing with wool from the time it leaves the sheep's back.

In New Zealand, the centre for textile research is the New Zealand Woollen Mills Research Association at Dunedin which employs a small staff which does routine service work on mill problems, interprets to the New Zealand woollen mills the research findings made overseas, and undertakes research into problems of local importance. Three examples of actual activities will be mentioned.

The first was a mill problem, and involved the modification of woollen ring spinning machinery. In this machine the redesign and resetting of the cams controlling the motor speed and the lift of the ring rail, the use of heavier travellers, and a change made in the shape of the bobbins resulted in increased production, better packages of yarn, and more efficient spinning.

The second concerns an anti-shrinkage process which was devised at Torridon, Leeds, by the British Wool Industries Research Association and patented by that Association under the name of the "Woolindras" process. The patent rights were made available to New Zealand, and a small-scale plant was imported. This was tried out under New Zealand conditions, and its features were demonstrated and its working explained to mill owners by the Research Association's scientific staff. The process involved the use of dry chlorine gas under precise control and careful manipulation before it gave satisfactory results with woollen yarns and fabrics, and so some scientific guidance was essential before full-scale plants were installed, as they have been since, in a number of New Zealand woollen mills.

The third example shows how textile research can help in a purely local problem. Pre-lamb shearing is a practice which originated in Otago and has been somewhat localized in the South Island. Fleeces shorn in late winter and early spring, prior to lambing, have a generally loose texture and, of course, in the first year that pre-lamb

shearing is adopted, the wool is short in the staple because it comprises only nine months' growth. These features provided wool buyers with another reason for keeping their bids lower because of alleged defects which they contended actually existed in this class of wool.

Dr. L. F. Story, Director of the Woollen Mills Research Association, in collaboration with G. Holmes, Superintendent of Invermay Research Station, undertook a thorough examination of pre-lamb shorn wool of twelve months' growth, from Romney and Corriedale flocks, right from shearing to fabric manufacture. By comparison with post-lamb shorn fleeces from the sheep of the same flocks, the pre-lamb wool showed its superiority in grading and freedom from faults, it carded and combed to a more uniform and greater average length, and it spun more evenly and gave yarns of greater strength. With these results from very exacting trials, it has become difficult for wool buyers to justify paying a discount price for pre-lamb shorn wool.

Spontaneous Combustion of Wool

From time to time serious fires have occurred in wool cargoes aboard ships and in wool stores. These are usually attributed to spontaneous combustion arising from wool being baled and dumped while moist.

The Dominion Laboratory has been working on this problem for some time and the results to date all indicate that the prevalent idea of dampness being the cause of these spontaneous outbreaks of fire is a mistaken one. Exhaustive tests both in the laboratory and in a full-scale trial have repeatedly shown that damp wool baled will certainly heat, but will never reach a temperature when it will actually burn.

There has been found only one exception to this and it refers to pie wool, the product of the bacterial process used in freezing works to remove wool from small pieces of sheep skins. In this process, fat from the fleshy skin permeates the wool during the pieing process, and, unless very completely removed in the subsequent scouring, some of the fractions of this fat appear to possess very inflammable characteristics when associated with wool fibres. The actual process of igniting is as yet not finally understood, but it appears that dampness alone will not cause baled or dumped wool to burst into flames.

Wool Textile Research Overseas

The main world centre of wool textile research is Leeds. Here research is carried on at Leeds University and at Torridon, where the extensive laboratories of the British Wool Industries Research Association are located. The next important centres are in Australia, at Melbourne, Geelong, and Sydney. In the U.S.A., the Textile Research Institute at Princeton University does important textile research to which reference will be made. South Africa has its Textile Research

Institute at Grahamstown. At Glasgow University, Galashiels, and in Europe at Delft in Holland, Mulhouse in France, and Heidelberg in Germany, certain textile research is proceeding with the assistance of International Wool Secretariat funds.

At present I.W.S. funds allocated for wool textile research amount to a total of £72,209, of which New Zealand's share is £16,608. Such a co-operative scheme is very advantageous to the I.W.S. co-operating countries, Australia, South Africa, U.S.A., Great Britain, and New Zealand, as all share in the advantages arising from combined effort and expenditure.

As New Zealand ranks second to Australia as a wool-exporting country and is the principal exporter of crossbred wools, most of which go to the United Kingdom for manufacture, it is most interested in the textile research work done in the United Kingdom. Because of the great preponderance of merino wool in its clip, Australia is concerned, in its three textile research centres, mainly with fine wool problems. While these problems may apply to a certain extent also to crossbred wool, this extent is likely to be limited. Hence, as New Zealand could scarcely justify maintaining a large textile research station on account of the small size of its woollen industry, it must depend principally on such research stations as Leeds and Torridon for scientific guidance.

Leeds University

Professor J. B. Speakman, who visited New Zealand in 1955, occupies the Chair of Wool Technology at Leeds University and is in charge of a Department whose staff is engaged in a wide range of problems, many of them of a fundamental character relating to the chemical and physical characters of the wool fibre. The general trend of the present investigations is designed to find the chemical weak spots in the composition of wool with a view to their rectification. A study is in progress on the crosslinkages which hold the fibre structure together, with a view to their being replaced by other chemicals which will prove satisfactory in rendering the fibre stronger. Several reagents which actually give additional strength have been found, but they impart other characters which render their use undesirable.

Another approach to giving additional strength to wool fibres is being explored. Inside wool fibres there exists a 25 per cent. free space, and the possibility of filling this space with a suitable synthetic polymer of the nylon type is being studied.

The physical structure of the wool fibre is still being investigated and new instruments such as the electron microscope and the ultra-centrifuge are being used for studies of wool scales which play such an important role in each part of the wool manufacturing process, in laundering and in felting. The combination of physical and chemical structure and character requires a great deal of study which will ultimately explain the distinctive behaviour of wool during

manufacture and subsequent use. For example, Professor Speakman's original researches have explained the process whereby permanent pleating character can be imparted to wool fabrics.

At Leeds University, a great deal of attention is devoted to research connected with the dyeing of wool and this involves studies of the physical structure of the cortex to ascertain where the dye granules are deposited in order to ensure that a good, even shade of colour is secured.

During manufacturing, woollens often become highly charged with static electricity which causes difficulties which have not been readily solved. One method, perfected at Leeds, of overcoming some of the trouble caused, is by the use of radioactive iodine, which, combined with the wool, dissipates the charge.

Another mill problem, concerned with the manufacture of worsteds, is the degree of hairiness shown by projecting fibres occurring in the yarn. Recently a means of measuring this hairiness has been invented at Leeds, and an instrument was developed which will enable mill operatives to carry out the measurement and thus provide valuable guidance in the spinning process and give a finished cloth of better appearance.

Torridon

Dr. A. B. D. Cassie, who visited New Zealand in 1955, is Director of the Wool Industries Research Association at Torridon, a suburb of Leeds. The New Zealand Woollen Mills Research Association is organized along similar lines, but is on a very small scale compared with the fine extensive laboratories of Torridon. In both countries, the woollen manufacturers and the Government, through the Department of Scientific and Industrial Research, finance and plan the programmes of the Associations. In New Zealand the New Zealand Wool Board makes a grant to the Association in Dunedin, and through its participation in I.W.S. the Association also participates in the grant made by that body to Torridon.

At Torridon some very useful mechanical devices have been invented to improve the working of woollen mill machinery. An automatic electronic controller which ensures an even weight in the slubbings delivered to the carding machine enables this machine to provide a more even sliver of wool.

The Raper auto-leveller is an outstanding example of an automatic control which ensures that sliver can be made perfectly even, thus ensuring improvement in all subsequent processes up to the spun fabric. This device is said to eliminate four machines in drawing, reduce the number of operatives from six to two, and effect a considerable saving in waste and in floor space.

Studies are being made of variations arising from tensions occurring in yarn during the weaving process, because it has been found that such variations cause defects in the finished fabric.

Chemical and physical studies of a very fundamental character are in progress at Torridon. It is notable that at Torridon chemical

studies of keratin, the principal and very complex protein component of the wool fibre, undertaken by Martin and Synge, led to the discovery of a new and most important method of carrying out the difficult chemical analysis of proteins. This is known as chromotography, which is very widely used today throughout the chemical world, and earned the Nobel Prize for its discoverers.

After sorting, scouring is the first process in the manufacturing of wool into yarn or fabric, and its purpose is to remove dirt and grease, leaving about 0.5 per cent. oil in the scoured product. Soap and soda solutions have been used in the past in the various bowls of mechanical scouring plants, but in recent years chemical detergents have come into favour and these have involved some changes which have necessitated scientific guidance to the operators. Chemical detergents present a difficulty in scouring in that it is not readily possible to ascertain the oil or fat present in the scouring bowls. However, a chromatographic method for doing this has been devised at Torridon, and this enables a greatly improved control to be imposed over the scouring operation. Torridon investigations have shown the need for design in scouring equipment to avoid uneven running of the wool through the rollers of scouring plants.

In Australia and Sweden, research is nearing completion on the design of plant in which wool will be cleansed by the use of solvents. It is hoped thereby to avoid the damage caused to the fibre by the mechanical actions occurring in existing types of plant.

As the result of fundamental studies on the removal of moisture from wool done at Torridon, an air flow design of dryer to deal with the wet wool from the scouring plant has been produced. In this dryer, felting is reduced to a minimum, and the efficiency factor of the steam is markedly increased. Whereas a waste fraction of one-eighth in subsequent combing was normal, this has been reduced to one-twelfth. Though this may be regarded as a small improvement, its application to the Australian clip would increase its value by some £2 million to £4 million annually.

The shrinkage occurring in wool fabrics during washing has long represented one of the greatest drawbacks to wool. Several treatments have been devised to overcome this defect and are in practical operation, but the search for improved methods continues. At Torridon, the original dry chlorination process, known as "Woolindras," was developed in 1938. This method is now in use in nine countries and some 150 million pounds of wool, mostly in the form of tops and fabrics, have been processed by it. Two other processes, the "Perzyme" and the "Chlorzyme" have since been patented. The Chlorzyme process is specially suited for treating washable wool quilts. Quite recently another anti-shrinking process using peracetic acid and papain has been patented, which gives, in addition to a good shrinkage resistance, a good handle, and good bleaching. Treated wool has also reacted better to subsequent dyeing, the shades being cleaner in appearance, while the soft handle of the wool is not impaired.

PRINCETON

With the assistance of I.W.S. Funds, the Textile Research Institute at Princeton, New Jersey, U.S.A., is investigating the influence exerted by crimp on the quality of the fabric made from wool of different crimps. Two Australian merino wools of "high" and "low" crimp respectively, but of identical fibre diameter (fineness), have been used in this test. In the processing, the high-crimp showed its superiority in spinning and yielded a fabric softer in handle, more pleasing in appearance, with a slightly better drape, and improved crease recovery.

This study is probably the first scientific approach to learn the influence which various characteristics of the greasy wool fibre exert on the quality of the finished fabric. In this case crimp has been selected first for special study, and the reactions of the fibres in each stage of manufacturing process are the subject of careful physical and chemical investigations.

Before worsted rovings are spun into fabric, it is usual to store them for some days to "age." The purpose of this was to allow the wool to regain a stable condition after all the physical stretching which it had been subjected to in the series of mechanical processes through which it had passed. Princeton investigators showed that this relaxation or stabilization could be brought about more rapidly by steaming the roving, which, in addition, improved its spinning quality. This has enabled a marked saving of time in the manufacture of worsteds.

Two Japanese scientists, Horto and Kondo, studying the structure of the wool fibre in recent years, found that the cortex was formed in two definite sections split along the length of the fibre. These sections are known as the ortho- and para-cortex portions. The keratin of which they are composed possesses different physical and chemical properties and so they react differently when dyed. This finding gives an improved explanation of the reaction of crimped wool fibres in the dye bath. The dyeing process exerts a mildly deleterious effect on the wool fibres and it has been shown that high-crimp wool resists damage better than does low-crimp, and this in turn is reflected in the handle of the fabric.

Princeton has devised an improved method for conducting compression tests with wool fibres. The compressional behaviour of wool is important in many of its uses; load rather than resilience is the important feature in compression. Tests of two Australian wools similar in every respect, but differing markedly in crimp, revealed that the high crimp sample gave a 70 per cent. greater resistance to compression.

AUSTRALIA

In Australia an extensive programme of research has been initiated with the aim of improving the use of wool as a textile fibre. This work is complementary to research in sheep husbandry and its major aims are:

(1) To increase the knowledge and understanding of the complex structure of the wool fibre.

(2) To utilize this knowledge to improve wool as a textile fibre, to improve technology in wool processing, and to utilize by-products more fully.

(3) To improve machinery used in wool textile manufacture.

Research on fundamental properties of the proteins found in the keratin of the wool fibre is being actively pursued while physical studies of the structure of the fibre are also in progress. Frictional studies associated with the movement of yarn and thread round steel cylinders at various velocities have shown unexpected results which are of importance in cylinders' speeding up manufacturing processes. Research is proceeding on moisture regain, which has an application for processing control and also may throw light on the molecular structure of wool. The amino acid content of fine and coarse Merino and of Corriedale wool has been shown to vary markedly and this variation may be reflected in the handle of these wools.

While the range of fundamental studies is very extensive, a number of applied problems are also being investigated and these include carbonizing of seedy wool, branding fluids, wool grease, shrink proofing, and moth proofing.

Wool textile research in Australia was commenced very recently and may be regarded as a post-war development which has made remarkable progress since its inauguration.

* * *

In this review of wool textile research, samples of the type of work in progress have been quoted as examples of the field being covered. As it was fundamental chemistry and physics which showed the way to the production of synthetic fibres, so must fundamental studies be done on the complex wool fibre, if improved methods of manufacture and extended uses are to be found for wool.

Unlike synthetics, wool is an old manufacturing industry which has a remarkably fine tradition built up on the accumulation of years of experience, which has given it techniques, machinery, and skill of a unique character. It is on this foundation that science is called upon to effect improvements using methods and resources which have become available only in recent years. Answers must be found for weaknesses alleged to be found in wool thread and fabric, and less costly manufacturing processes which give still better quality fabrics must be searched for in order to meet the challenges which wool faces today.

Sound research in the textile field and its application in the mill will serve to strengthen the I.W.S. slogan, "There is no substitute for wool."

DISCUSSION

Q:: *Why are the coarser wools bringing better prices on today's market and less attention being paid to crimp?*

A:: I think that probably is a purely economic question. The production of the finer wools has increased temporarily at a greater rate than the coarser wools have done. Crimp, however, as an indicator of fineness, has always been an important feature of wool to which buyers will pay attention. At present the scientific knowledge that has been gained recently about the effect of crimp has not permeated very far. A very complex piece of research is going on to ascertain just what factor in wool is most important in the finished product. These researches, which are being done at Princeton, in the United States, indicate that there are distinct differences which show up in the finished products, as a result of variations in the nature of the original crimp. I think that the price difference at present is due to an economic rather than to a scientific cause.

MR. WARDELL:: Following on Mr. Callaghan's explanation, perhaps the questioner was wondering why 46's are fetching a better price than 48's. I think that that is the influence of the carpet industry. The carpet industry is moving forward rapidly, because of the influence of the hire-purchase system. It is not able to get all the Indian wools that it requires, and so carpet manufacturers are using more and more of our crossbred wools to meet their requirements. This is an important reason why, when sorting your wools, you should take out the very coarse wools, because they will fetch, on today's market, a better price than your fine wools. This is a phase which may not persist, of course.

THE QUESTIONER:: I am sorry, Mr. Chairman, my thoughts were moving along a different line altogether. While I was abroad two years ago, I visited the Royal Show in Great Britain, and was absolutely astounded at the hairiness of the wools on the British sheep—nearly all breeds showed this, though perhaps not the Southdowns, and one other breed that I am unable to name at the moment. I also went through a woollen mill in Scotland, one of the few where the raw material is handled. I saw the Scottish Blackface wool going in at one end of the place and coming out as a finished article at the other. It came out looking very different from when it went in! It went in looking like sticks and barbed wire! I can assure you that the British manufacturers worry very much about crimp, and about good quality wools from this country. It has appeared to us that the buyers do not worry very much about crimp.

THE CHAIRMAN:: Mr. Callaghan, were you referring to worsteds or woollens when you were speaking about the importance of crimp? I presume the mill mentioned by the questioner was Galashiels?

THE QUESTIONER:: No, it was a mill located north of Inverness.

THE CHAIRMAN:: Making woollen goods?

THE QUESTIONER:: Yes, scarves and blankets and such like.

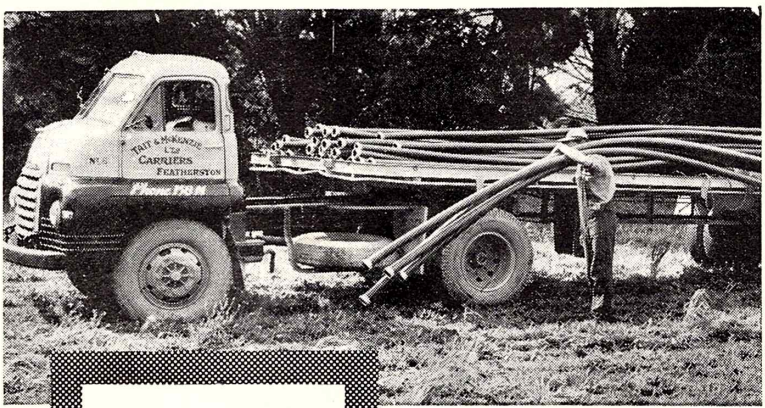
THE CHAIRMAN:: Well, does crimp come into the picture to the same extent with the woollen section of the trade as it does with the worsted section?

MR. CALLAGHAN:: No, I do not think it does. It is in the fine wools that crimp is so important.

Garnite

CONTOUR PIPE

Photograph shows 2½" pipe being delivered for large installation at Featherston Co-op. Dairy Co. pig farm.



ECONOMICAL
NON RUSTING
PERMANENT
LIGHT WEIGHT
EASILY
INSTALLED

In factories and on farms throughout New Zealand increasing use is being made of CONTOUR PIPE, a tough flexible tubing, manufactured from Polythene, that is unaffected by exposure and chemical reactions, skim milk, etc., which deteriorate metal pipe. Contour Pipe is obtainable in complete lengths of 50, 100, 200, 300, 400, 500 and 600 feet for rapid installation, and an extensive range of brass and gunmetal fittings is available for use with Standard Gauge pipe. In bore sizes of ½", ¾", 1", 1½" (std. only), 2", 2½", 3", 4" (heavy only).

Manufactured in New Zealand by A.C.I. PLASTICS PTY. LTD.
Penrose Auckland

Sole Selling Agents: NEILL, CROPPER & CO. LTD., Pukemiro Chambers, C.P.O. Box 74, Auckland. Box 583, WELLINGTON; Box 1378, CHRISTCHURCH; Box 703, DUNEDIN.

Your home will stay

BRIGHTER CLEANER, LONGER

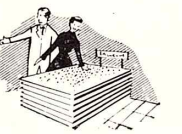
with

Tattersfield

SOIL-RESISTANT
BODY CARPET

FIRST IN NEW ZEALAND

Tattersfield Super Axminster Body Carpet is now availible featuring the new, exclusive "Soil Resistant" Treatment.



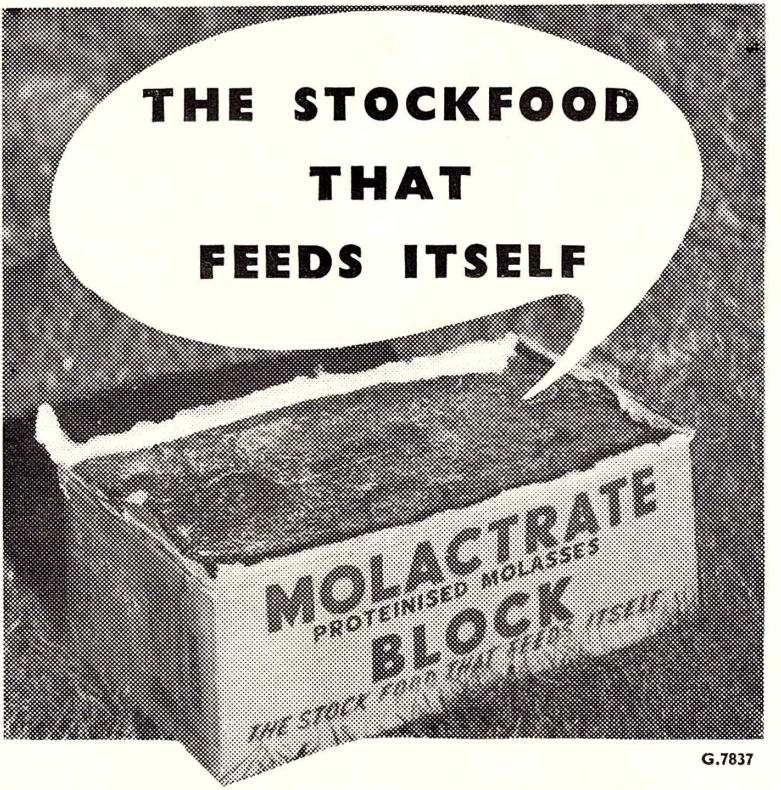
Stays cleaner up to 4 times longer

Guaranteed Permanently Proofed against Carpet Beetle

A QUALITY PRODUCT OF Tattersfield LIMITED, AUCKLAND

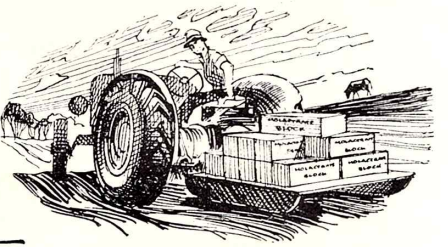
Available from all leading furnishers

SF11



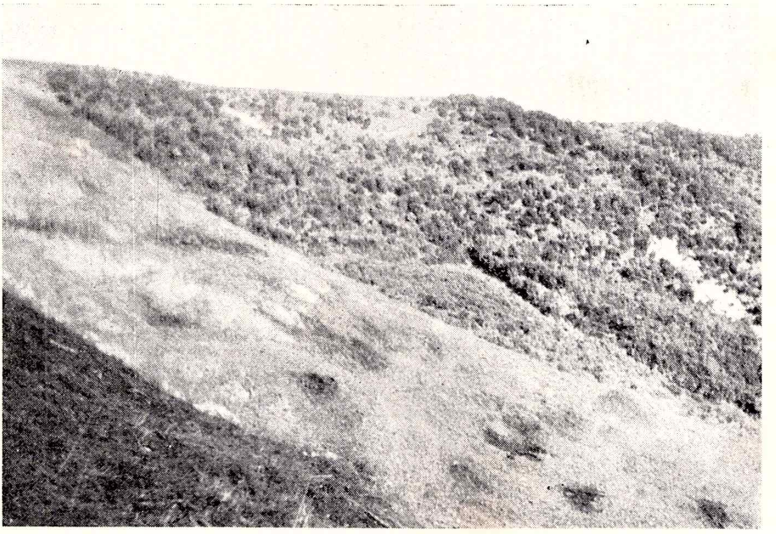
G.7837

HIGH in protein, rich in sugars, and containing no fibre, MOLACTRATE BLOCK is the most useful food supplement — summer and winter — which is available to the New Zealand farmer . . . for flushing ewes . . . for feeding rams before service . . . for carrying hoggets through the winter . . . and for eliminating 'sleepy sickness' from your flock. Dairy-farmers, too, know its value in wintering cattle.



Just put it out in the paddock— your stock do the rest!

Write for Free Leaflet to W. & R. Fletcher (N.Z.) Ltd., P.O. Box 594, Wellington.



Early development using draining spade to remove gorse bushes.

THE DEVELOPMENT OF UNPLOUGHABLE GORSE-COVERED HILL COUNTRY

E. FEIST*

THIS PAPER IS A STORY OF DEVELOPMENT over the last 15 years and in that short time many changes in farming methods have taken place. Thanks to research and modern machinery, the ability and ease of accomplishing the task in hand has enabled work to be tackled that only a few years ago would have looked absolutely hopeless and unprofitable.

The usual problem with this type of development is lack of finance to get a worthwhile start. This was so with the property discussed here and should be borne in mind.

Description of Farm

The farm is 900 acres. Fifteen years ago only 200 acres were able to be grazed; today 400 acres are free of gorse or are being developed. The farm is situated 10 miles by good road north-west of Wanganui, and has an altitude ranging from 500 to 1,000 ft. It has 100 acres of rich loam flats on the road frontage falling away to 220 acres of steep slopes of about 12 chains in length to a series of 80 acres of river flats of a light loamy soil. Through the middle of

**Farmer, "Waipuna", Brunswick R.D., Wanganui.*

these lower flats flows the Kai-Iwi stream for a distance of 3½ miles. North of this stream lies half of the farm in fairly steep slopes covered in typical Wanganui gorse interspersed with varying amounts of manuka, fern, blackberry, and black-vine. The rainfall of the area averages between 35 and 40 in. per year, which seems to be plenty to keep the gorse in good heart, the farm financially poor, but the farmer fairly fit. The flats have helped considerably in coping with the weed-covered hills and so the story of gorse development must of necessity be coupled up with the whole of the farming procedure.

This farm was first occupied in 1853 by the Hon. John Bryce who, incidentally, was a Member of Parliament for varying periods during the period 1866-1891. During his ownership, the farm was meticulously subdivided with gorse hedges planted on well-prepared ditches and banks. These old banks have been found in each paddock that has been cleared. Needless to say, the builders of these "cheap" fences have had a few harsh things said about them. The property also has a number of Maori trenches and dug-outs over it, so has some historical background.

Early Gorse Eradication Methods

The first paddock chosen for clearing of gorse was a hillside that was handy to the flat and lay well to the sun. The gorse was grubbed out by the roots using a draining spade—a very slow and strenuous but thorough method. During the following nine years, 85 acres were developed in this manner. After the grubbed gorse lay over the summer, a good, clean burn was obtained which provided a reasonably good seed-bed. Unfortunately, the stress at that time was on the cost rather than the quality of seed, and consequently a poor sward of grass followed.

The first hill paddock grubbed was fenced into 12 acres and stocked as heavily as was dared. The result was that the gorse seedlings got well knocked back but so did the grass, and the stock; a very discouraging result for all our labours. However, paddocks which have been won back from gorse are today hillsides really pulling their weight in the farm production. At this stage, having lost some of the earlier youthful exuberance, an easier method of doing this work was sought.

The draining spades were therefore put away and the slasher was used. This was certainly faster and considerably easier and in the next two years approximately 50 acres were cleared, using the same follow-up policy as with grubbing. After having attended one or two Sheepfarmers' Conferences at Massey, I put more emphasis on good grass seed mixtures and the over-sowing of subterranean clover plus more lenient grazing. These methods produced more heartening results as far as carrying capacity was concerned. Grubbing of the growing stumps following cutting was considerable but still made this an easier method of eradication than grubbing alone. The aim at that stage was to cut about 15 acres of gorse a year which was an improvement on about 10 acres a year using the grubbing method.

Even 15 acres a year was a small amount out of a total of 650 acres then in gorse and secondary growth, but with stock work, fencing, and cropping it was sufficient to keep two of us busy.

By 1950 we were given some encouragement with the advent of hormones and with high wool prices began with more hope and considerable faith in the future to increase our developmental work. That year a block of 30 acres of gorse was cut by contract and sowed with the best seed available. After a good fire the grass came up excellently. Fencing material was packed on to this paddock by horse and a good conventional seven-wire fence erected. This block was grazed extremely hard after weaning the ewes early and with 1,000 ewes on it for several weeks there was not much sign of gorse regrowth, gorse seedlings, or grass. In fact we were told in all seriousness that we would never see grass on it again!

The paddock was then spelled and, with treatments of on-and-off grazing, it carried on for two years till hormone applications were commenced. Incidentally, this paddock was given superphosphate at the rate of 2 cwt. per acre by aeroplane operating from an airstrip on the top flats. It was quite a thrill to see the superphosphate going on by 'plane for the first time after the drag of hand sowing for so many years.

Hormone spraying of this paddock involved several difficulties, the major one being inexperience, but with a little perseverance these were overcome. Having a stream with plenty of water at the bottom of the job was a great help. To begin with, a high-pressure 1.4 h.p. pump and 100 ft. of hose were used but it was found that carrying the pump to the water's edge to pump up water was tedious and costly so a second pump and some alkathene hose were purchased. The water could then be pumped some 600 ft. to the top of the ridge a little faster than it was needed for spraying back down the face. The length of spraying hose was ultimately increased and, with a colour added to the spray, the work progressed satisfactorily with much valuable experience for further spraying operations being gained. This paddock is now producing a good sole of grass with clover quite prominent. However, the war with gorse is not yet won, for seedlings keep appearing and will undoubtedly do so for a number of years yet. The first spraying operation for this 30 acre paddock in 1952 took 17 days to complete and the second spraying two years later took three days. A third treatment will be necessary again next year. This gives some idea of the persistence of the gorse seedlings in badly infested country.

Present Gorse Eradication Methods

Satisfactory as this earlier work has proved, it was obvious that greater advantage could be taken of more modern methods, and after some thought and discussions with experienced men and research workers it seemed worth while trying the development of a block of 60 acres by burning the standing gorse. A block of dense gorse that had not been burnt for six years was selected and a fire break cut

around it to prevent burning of fences. The patch was burnt on March 5, 1954, and sown by Tiger Moth 'plane a week later with a mixture comprising 10 lb. perennial ryegrass, 5 lb. short-rotation ryegrass, 2 lb. cocksfoot, 2 lb. dogstail, ½ lb. browntop, and 2 lb. of white clover. The aim was to obtain the best seed procurable. Quotations from three firms were obtained and the firm with the main lines testing well for purity and germination received the order.

The tests of this grass seed may be of interest, as I am sure that good testing seed plays a most important part in the success of this type of work.

	Purity	Germination
	%	%
Perennial ryegrass	99.9	98
Short-rotation ryegrass	99.5	91
White clover	99.6	96
Cocksfoot	91.8	85

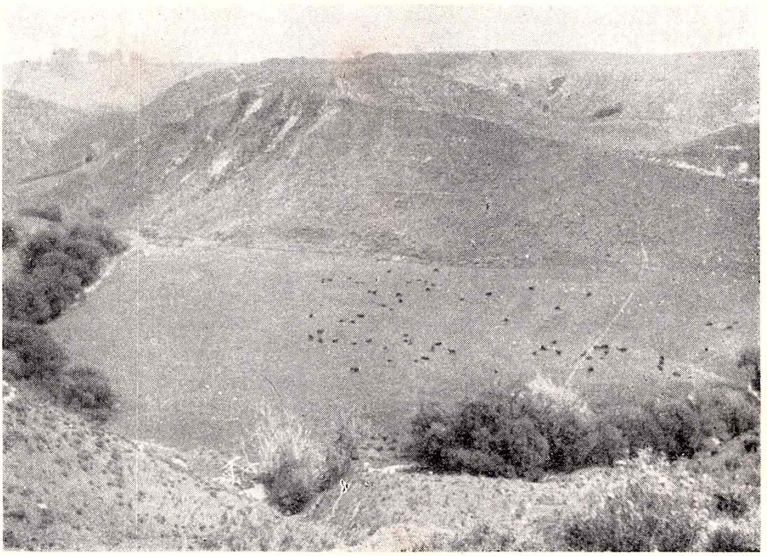
The rate of sowing was approximately 21½ lb. per acre. This was a comparatively light sowing, but as seed prices were high at the time it was considered wise to get the best procurable and use less seed per acre. Though a heavier sowing would have been desirable, a worthwhile coverage of grass and clover was obtained. The paddock was given lenient grazing throughout the winter, enabling the grass to establish. During the early spring, yearling cattle were put on and these began the good work of opening up the gorse and also crushing the small amount of fern that came up. The cattle were left on the block until mid-spring and replaced with dry sheep until weaning of the lambs when all the grown sheep available, amounting to 1,200, were put on and left till all grass was eaten off and a lot of young gorse shoots too. A very dry summer helped to make this hard grazing complete.

The paddock was topdressed in March, 1955, with 2 cwt. of superphosphate and oversown with 2 lb. per acre of white clover harvested from our own pasture on the flat. The block was grazed from March to July by 500 wethers which kept the paddock really bare. From July onwards sheep were removed and cattle put in when sufficient feed had appeared. With a good growing spring, the feed came away fast and the clover seemed to flourish particularly well—as did the gorse.

Unfortunately, sufficient dry cattle could not be raised on the farm. Arrangements were accordingly made with a local dealer who supplied 100 head of cattle which grazed the area for the remainder of the spring and right through the summer. It was considered wise to keep sheep out of the paddock prior to spraying as less young shoots would be eaten off and there would be a better chance of the hormone spray being more effective.

Hormone Spraying

When spraying commenced in mid-December, 1955, the gorse had grown to a height of three to four feet and had ample spines to



Hillsides coming into production.

absorb sufficient hormone to effect a satisfactory kill. The method of spraying may be of interest. Some 2,000 ft. of alkathene hose was laid up the main ridge from the stream adjacent to the area to be sprayed. Water was pumped from the stream by a high-pressure 1.4 h.p. pump to at least a dozen 44 gal. drums set on a convenient spot as near the top of the work as the alkathene would reach. This pump was started first thing in the morning and a tank full of petrol would fill approximately 10 drums in 3¼ hours.

A similar pump was placed alongside the drums and, with a lead of 700 ft. of two-ply anti-solvent rubber hose, a section from top to bottom was sprayed. A section roughly 5 chains wide was sprayed down-hill in zig-zag strips, each approximately ½ chain wide. The hose served as a marker for the spray line. When the bottom of the hill was reached, a similar 5-chain section was sprayed to the top again in ½-chain strips as before. The contour of the hill and the density of the burnt gorse determined the section and strip widths. By working in this way, a very thorough spray coverage can be obtained, which is all-important in any gorse spraying operation.

The person at the drums, usually my wife, would mix the hormone and change the hose over as each drum filled with water. The mix used was 1½ pints of 2,4,5-T to a 44 gal. drum to which a heaped dessertspoonful of methylene blue was added to colour the mix. This dye costs 1s. per drum of spray mixture. Special care was taken to see that the mixture was well stirred and *kept* stirred. Two of us did the actual spraying, and, other than stops for fuelling and greasing,

the job went on for 10 to 11 hours a day continuously, one carrying on with the spraying while the other had smoko or lunch. On a day with everything going to plan it was possible to spray about 4 acres, using 1,100 gal. of mixture.

Great care was also exercised to make sure that each bush was given a good coverage without a wasteful run-off. A good plan is to make the last drum of the day a bit stronger in colour so that the area last sprayed can be more easily picked up next morning. Thus time and material are saved.

With a good length of spraying hose, a large area can be sprayed without shifting all the gear, such as drums, pump, and tools. At least 10 acres can be sprayed by operating in sections and strips on all sides of a main ridge from the one central site where the gear is situated.

On this particular job, the spraying gun was not shut right off during operation and so a good pressure of 300 to 350 lb./sq. in. was maintained without damage to the hose. In spraying the whole block of 60 acres, 25,000 gal. of mixture were used and only one break in the hose occurred. In spraying scattered gorse, however, the pressure is cut down to about 200 lb. and so the necessary shutting off of the gun does not damage the hose to the same extent.

The cost of spraying the 60 acres, including wages, hormone, methylene blue, and plant depreciation, worked out at £11 per acre. A contractor, however, tendered a price of £18 per acre for this particular job.

After the completion of spraying, the paddock was topdressed with 2 cwt. of superphosphate and oversown with 2 lb. of white clover to the acre to compensate for the loss sustained to previous clovers through applying 2,4,5-T. Incidentally, the clover was grown and harvested on the flat portion of the farm and sent to Palmerston North to be cleaned and tested. A certificate showing a purity test of 99.6 per cent., and a germination test of 82 per cent. was obtained for this seed.

The cattle were removed from the newly sprayed paddock on May 20, 1956, and the paddock is now under spell till early spring when yearling cattle will be put in to take the top off the grass and knock the sprayed gorse about and so let the light in to the pasture. A good job seems to have resulted from the spray but a certain amount of regrowth is appearing. This is disappointing but apparently it must be faced up to till the day when the hormones are made more efficient.

Expenses involved in development are: Fencing, 60 acres at £6 per acre using the Hunter fence; grass seed (21½ lb. per acre) at £2 12s. 6d. an acre (1954 prices); aerial sowing, 5s. an acre; spraying, £11 an acre; oversowing after spraying, 15s. an acre; top-dressing, £1 6s. 0d. an acre. These costs total £21 18s. 6d., but they are spread over two years. Developing this country by contract would cost probably £10 per acre more.

Newly cleared hillsides.

Once the land is cleared, it must of course be stocked, preferably with wethers and cattle for the first two or three years but thereafter these can be replaced with ewes and breeding cows. Money spent in developmental work of this type is free of Income Tax so it is not as costly as it would seem.

Many people say the land is not worth clearing and use this excuse for doing nothing about it. My answer is that the land is well worth clearing. The first area we cleared now supports at least 3½ ewes per acre plus cattle, returning some £18 per acre annually.

It is a work where one must be prepared to wait about three years before any of the money spent can be recovered, but like the rolling stone it soon gathers momentum and paddocks cleared soon help to provide finance for further development.

Expenses involved in annual maintenance are 2 cwt. of manure at £1 6s. 0d. an acre plus scattered gorse control at 5s. an acre as well as fence maintenance at, say, 10s. an acre. These costs total £2 1s. 0d. per acre. This leaves a gross profit of £16 per acre but, of course, this figure does not take into account items such as rates, interest and stock-handling charges.

Erosion

Following in the wake of gorse clearance comes the problem of slip erosion. At first this is very disheartening but, if the slip faces are sown in the spring with a mixture containing a good proportion of subterranean clover, the problem is not as serious as it first appears. Slips soon heal if the grasses and clovers are leniently grazed. Slipping rarely occurs once a good sward is obtained and if grazing is not too severe. The hillsides eventually consolidate and stock tracks contour the faces which slows up the water run-off. It takes seven or eight

years before these stock tracks appear and the hillside becomes stabilized.

Hunter Fences

A considerable aid to reducing costs has been the introduction of Hunter type fencing. An efficient and comparatively cheap fence can be erected by placing posts 12 yd. apart and using five steel 12½ gauge wires and a barbed wire top and bottom with chain droppers every three feet. In spite of sceptical remarks, these fences have been entirely stock-proof, even when blocks have been stocked for crushing purposes at the rate of 20 sheep per acre for four weeks or more.

The cost of erecting this type of fence at the most inaccessible part of the farm has been £350 per mile using contract labour. Furthermore, a fence line along a ridge 50 chains in length was completely laid in half a day by two men.

* * *

At this point, the methods and principles involved in development may be summarized as follows:

(1) Choose a block where the gorse is about six years old and burn this in mid-autumn. The fire provides a good seed-bed.

(2) Best quality seed should be sown by aeroplane within a day or two after the burn.

(3) The area must be fenced after the sowing of the grass seed. Hunter fences are efficient and economical for this purpose.

(4) Six weeks after sowing, the grass is ready for grazing. A large mob of wethers should be allowed to take the top off the new grass. The grazing at this stage helps in clover establishment, gives the soil a fertility boost, and many seedling gorse plants, fern fronds, and blackberry shoots are eaten off in the process.

(5) Future stocking with sheep and cattle opens up the burnt gorse. This makes the block easier to spray.

(6) Superphosphate is applied from the air the first year after the fire. Thereafter topdressing is carried out annually at the rate of 2 cwt. per acre.

(7) Hormone spraying takes place two years after the fire.

(8) After spraying it is imperative to oversow with subterranean and white clovers to make good the death of clovers as the result of hormone application.

(9) Before any of this work is contemplated, budgetary costings and work organization must be planned. Likewise, stock of the right type should be available at the appropriate times.

* * *

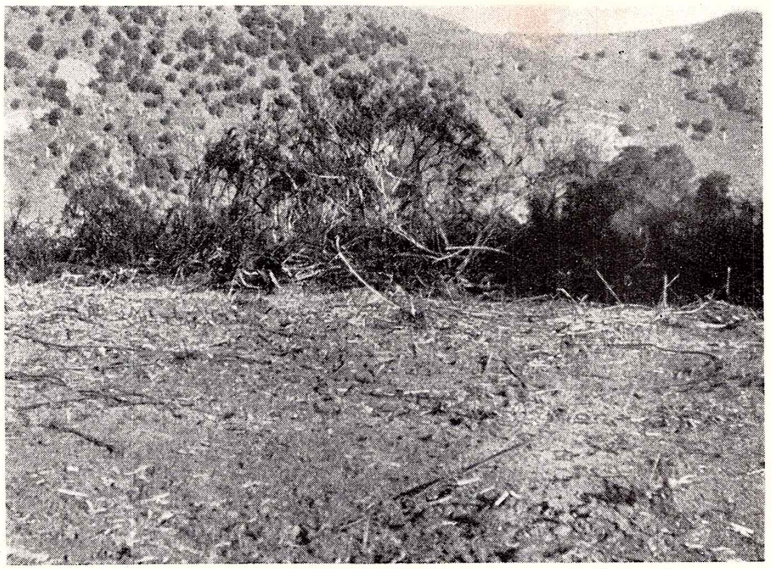
With the advent of the hormone weedkiller comes new life in tackling the problem of clearing secondary growth off our second-class land and with it the realization of the difficulty of raising sufficient finance to make more worthwhile progress. In a leading article in the *Wanganui Chronicle* of May 28, 1956, comes a suggestion that a Gorse Clearance Fund should be established. The

article wisely points out that, while a farmer benefits from his own efforts of clearing land, so does the community as a whole. Land won back to production is helping to meet the taxation bill, a thing it has never done before, and it will, if properly managed, contribute to that fund in perpetuity. Further, it is helping to produce food and clothing for the peoples of the world both now and in time to come. Nearer to home it is raising store stock that farmers on our first-class land need in order to stock their properties sufficiently well. There is surely much merit in the proposal for some sort of government aid to win back land that is at present idle but that could in two or three years produce stock and wool to the gross value of £18 an acre annually on present day prices. The article suggests the Minister of Agriculture should set up a committee to explore the proposal and it is hoped that some of the results given here might add some weight to that suggestion.

Bulldozing Gorse

In the last season 20 acres of gorse on flats and round the banks of the Kai-Iwi stream have been cleared using a 22 h.p. crawler tractor with a 6 ft. hydraulically-controlled blade. It is essential that the gorse be burnt first as this gives the driver a better and safer view of his work, and a quicker and more thorough job results. It takes about 12 hours to do an acre thoroughly with the bulldozer.

After bulldozing, the land is giant disced and allowed to remain in that state over the winter. During September it is sown in rape at the rate of 6 lb. per acre. The crop is ready to feed off early in February, when the crop is thoroughly ripe. Enough lambs are put on



Gorse and blackberry had been recently bulldozed off this flat.

to this crop to have it completely grazed off by mid-March so that the ground will be ready to sow to permanent pasture at the appropriate time.

Trees for Smothering Gorse

On some of the very shady areas of the farm it is proposed to plant trees. One such area has already been planted in radiata pine with the trees about 10 ft. apart. Tracks were cut first and then trees procured from a local nurseryman and planted the same day. They were planted during the latter half of July and August and are effectively smothering the gorse. It appears to take four years for the pines to become complete masters of the situation. The great drawback to the method is the fire risk, which is very considerable in country such as this where one match could burn hundreds of acres. Consideration will be given to planting another area in macrocarpas so that the timber may be used on the farm by future generations.

The cost of putting in these plantations must not be overlooked. Approximately 600 trees per acre are needed, costing about £20. The labour involved in cutting tracks and planting absorbs another £35, so that an outlay of £55 per acre is needed, and this figure does not include fencing. There is a fire risk and risk of damage to young trees by opossums. Obviously, not a great area could be handled in any one year.

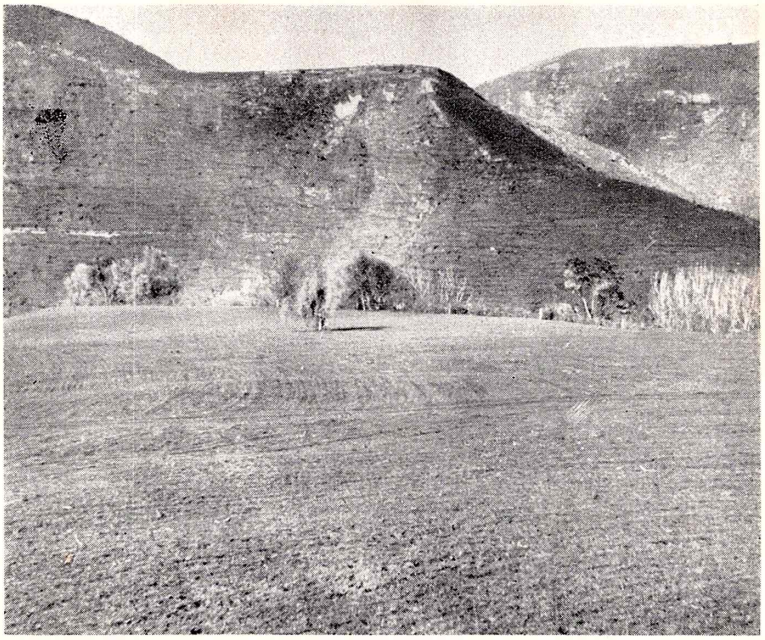
Bulldozed Tracks and Bridge Construction

On the far end of the property grows a considerable amount of large, white manuka which is being disposed of to firewood merchants on a royalty basis. This has been made possible by providing access facilities in recent years. Three miles of track have been bulldozed and a bridge has been constructed over the Kai-Iwi stream. This access has enabled fencing, cropping, and bulldozing to proceed more quickly as trucks can transport materials right on to the job.

Construction of the bridge presented a problem, but, by employing an engineer to survey and plan and also assist in building, a good strong bridge has resulted. The foundations are of concrete to a depth of about 5 ft., and these support three 15 in. steel girders 32 ft. long. The decking is made of creosoted radiata pine and is in three layers, the middle layer being laid diagonally. The floods come over the deck so no sides have been put on. Old tyres have been used to stabilize the banks on each side; these have done a very good job and no sign of erosion has appeared where they have been used. The bridge is capable of carrying 12 tons, is 32 ft. in length and 10 ft. wide, and cost £470 to build. It is a great boon for shifting sheep as the previous access was by an old swing bridge which made moving sheep, especially ewes and lambs, a slow and tedious procedure.

Farming on the Flats

While the gorse clearing has been in progress, the flat area has been fairly intensively farmed so that a sufficient number of stock for crushing gorse blocks would be maintained and as much finance



Flat ready to sow to pasture. This paddock was earlier cleared of gorse and blackberry using the bulldozer.

as possible would be provided to enable a worthwhile area to be cleared annually.

Paddocks averaging 8 acres in size were ploughed, choosing the poorest pastures first, and after a fairly deep ploughing and a light discing were sown straight into choumoellier, using about 3 lb. of seed per acre. Sowing was done in early November and when the crop was about 3 ft. high (by February), the weaned lambs were put on and allowed to defoliate it only. The paddock was then closed till June when there would be a good crop 6 to 7 ft. high. This crop would graze 100 hoggets per acre for six weeks after which cattle were put on to the stalks and chewed them right off by the end of August. Hay was always fed to the cattle while grazing these stalks.

The area was cultivated again in September and several crops from then on have been tried, including rape, oats, and turnips. Occasionally the area has been fallowed through the summer. All crops have been satisfactory but the most successful was a crop of rape. This last season rape was sown at the end of September and it had time to ripen well before being grazed in early February. Sufficient lambs were put on to clear the area by mid-March. It was then lightly disced with one cut and the best procurable seed mixture was sown. A mob of ewes was put on immediately after sowing to grass and left for five days to graze down the rape stalks. The result was a good even cover of seed and good consolidation which is very necessary. The

new grass now is most pleasing. A favourable autumn blessed this work and five weeks after sowing the first quick and fairly complete grazing took place; two weeks later the area was ready for another grazing lasting for two days, and then a further spell.

The present cropping policy is to sow swedes in mid-November together with a light sowing of choumoellier. The sowing rate is about 2 lb. of choumoellier and ½ lb. of swedes of the Superlative and Crimson King varieties. The crop is not grazed till June. The swedes do not grow big but are well shaped and very palatable, and increase the per acre grazing capacity of the crop.

When the pastures are put down, there is always a considerable growth of thistles, and small, flat weeds tend to dominate in the first spring. A spraying programme is carried out to eliminate these weeds. Early in September, when the flats will carry a truck reasonably well, they are sprayed with 1¼ pints 2,4-D per acre in 11 gal. of water. If spraying is done early very few thistles are missed. With the pump and drums on the back of the truck and a hose from these to a 13 ft. boom on the front bumper of the truck, an 8 acre paddock is sprayed in 25 minutes. The cost of this work is round 10s. an acre.

The main precaution in spraying seems to be the cleaning of the gauze inside the fan type jets which become quickly blocked with hairs and grime if the water is not absolutely clean. However, once the pressure and travelling speed are judged correctly, spraying is a very simple and efficient operation.

Cattle Management

Stock management on the flats and cleaned areas may be of interest. In October, 1951, a Galloway bull was purchased from Massey College, and was crossed with our old Aberdeen Angus cows which were of fairly mediocre quality. This bull left calves of deep bodies and shortened the legs considerably. Two years later a white Shorthorn bull of good quality was purchased and was crossed with the yearling halfbred Galloway heifers so that they would calve at two years of age. The theory was based on the fact that most dairy farmers bring their heifers to profit at two years and, as the run cattle of any beef breed are considered to have stronger constitutions than Jerseys, it was believed to be a fairly safe gamble to take this step provided the cattle were well treated. The first try out resulted in 25 calves of good type from 28 heifers. The colours expected were blue roans but, while some were true to this description, some were of various colours owing to the mixed ancestry of the old Angus cows.

Last spring, when the next lot of two-year-old heifers calved, the result was not quite so good. This was no doubt due to the severe drought experienced through the summer and autumn and short rations through the winter, but the experiment has given one faith to continue with this early mating policy. Previously all steer calves were sold as weaners. The future policy will be to winter the steer calves and sell them as chillers the following autumn, as with improved pastures extra stock is necessary through the spring.

One recent development on the farm was the culling of 300 ewes out of the 1,100 and replacing them with wethers to enable more concentrated stocking on gorse developmental blocks. This culling enabled an improvement to be made in the breeding flock and ultimately, it is hoped, in the wool clip.

A trial manure plot has been laid down on the property to ascertain the manurial and trace element requirements, if any, of the farm. This plot has been going for two years, and from what has transpired it would appear our only marked response is from phosphate and small quantities of lime. It was thought at one stage that our previous heavy liming on the flats may have been money frittered away and so the trial was instigated. No response has been apparent from molybdenum or from any of the other trace elements.

My thanks are due to F. E. T. Suckling and A. C. Glenday of the Grasslands Division and their assistants for their efforts in carrying out the manurial trials, and also to some members of the Sheep Husbandry Department of Massey College for their interest and advice in some of these new methods in our farming. The man on the land these days has many opportunities to grasp and I for one am grateful for all the advice which has been so freely given.

The Massey College Sheepfarmers' Conferences provide one opportunity where it is possible to sift out a lot of useful ideas and schemes and apply them to one's own circumstances. Sometimes mistakes are made by trying out new methods that are successful in some areas, but in the main one gains a lot of knowledge that would otherwise be missed. I have been attending these conferences over the last ten years and many of the methods of farming outlined in this paper have resulted from ideas gained during these conferences. I am grateful to Professor Peren and his staff for the work they have put in to make these opportunities possible and hope they may continue their good work for many years to come.

Appendix A: Cost per acre of Cutting and Grubbing Gorse (Old Methods).

	£	s.	d.
Cutting: 30 hr. at 8s./hr. =	12	0	0
Grubbing: 60 hr. at 8s./hr. =	24	0	0

Appendix B: Approximate cost per acre of Gorse Eradication (New Method).

	£	s.	d.
Seed (21½ lb./acre) and sowing by air	2	17	6
Hormone spraying (materials, labour, and plant depreciation)	11	0	0
Fencing (Hunter fence)	6	0	0
Topdressing—manure and 'plane charges (2 cwt. superphosphate)	1	6	0
Oversowing 2 lb. clover		15	0
Total	21	18	6

Appendix C: Bridge Construction Costs (Erected 1954).

	£	s.	d.
3 steel girders—32 ft. x 6 in. x 15 in.	111	17	2
Timber: 1,600 super feet at 54s. a hundred	58	4	9
Labour: 175 hr. at 5s. 6d./hr.	48	2	6
96 hr. at 7s. 6d./hr.	36	0	0
Bulldozer: 11 hr. at £2 1s. 0d./hr.	22	11	0
Creosote: 65 gal.	15	0	0
Cement: 21 bags	12	4	2
Petrol and cartage, etc.	10	0	0
Railage on girders ex Wellington	8	5	9
Used tyres (bank stabilization)	5	15	0
Concrete metal: 4 yd. at 27s. 6d./yd.	5	10	0
Cartage on girders ex rail	2	17	6
Malthoid: 64 ft.	3	4	0
Nails	2	10	0
Black paint	2	0	0
Raw tar	1	10	0
Cutting holes in girders	3	7	7
Reinforcing steel, H.D. bolts, tie rods, clips, etc.	70	0	0
Hire of tools, etc.	2	10	0
Mileage: 200 mi. at 9d./mile	7	10	0
	428	19	5
Engineer's commission: 9½ % on £428 19s. 5d.	40	12	0
Total	£469	11	5

The bridge is 32 ft. long and 10 ft. wide and is designed to carry 5 ton axle load between wheel guards and for stock driven over under normal droving conditions. An engineering risk would be expected under abnormal flood conditions.

Appendix D: Cost per mile of Erecting a Hunter Fence.

	£	s.	d.
Concrete strainers (12 ch. apart) and blocks	26	0	0
Posts (macrocarpa) 12 yd. apart	50	0	0
Wire: Plain steel, 12½ gauge (5 wires)	20	0	0
Barbed wire (2 wires)	20	0	0
Laying out on to fence line	10	0	0
Wire chain battens (1 yd. apart)	65	0	0
Wire clips	16	0	0
Foot blocks and footing wires (stainless steel)	10	0	0
Labour for erection	130	0	0
Total	£347	0	0

DISCUSSION

Q:: *Would it not be better to burn in early January when the gorse is dormant? A burn at that time often kills up to 90 per cent. of the old roots.*

A:: It is important to sow grass seed on to the burn as soon after burning as possible. By burning in early January you are running into dry weather, while, by burning later in February, the natural seed-sowing time is approached. My experience with burning standing gorse and sowing has been that where the gorse was not quite so well burnt there was a better seed-bed. The germination was much better in those areas where the seed got some cover from the sun.

Q:: *How long do you leave the cut gorse prior to burning? I have a theory about cutting gorse in the winter and leaving it until the following autumn before burning. In that way I kill a great deal of the older gorse as it is shocked very severely by cutting. It sprouts away through the dense top that has been cut off it, and then the fire through it does the final job. In that way I get a clean burn, which Mr. Feist says is a slight disadvantage to the grass seed. Nevertheless, one seems to get less regrowth from the stumps by leaving the gorse to regrow for nine months before burning.*

A:: The block that I mentioned which we cut in 1950 was cut in the spring. The job was actually finished in November. It was allowed to lie then till the end of February, when, as was just said, a really good burn can be obtained. This is the most thorough way of dealing with gorse, but it is also a very costly one. That is why we have tried this other method, that is, burning standing gorse and then sowing. This is a very rough way of doing the job, but it is cheaper and the final result is the same.

Q:: *Cutting before burning, in my opinion, gives a quicker return, because the stock go on to cleaner country. The wool, for one thing, is not damaged as the result of sheep walking among standing burnt sticks.*

A:: We try to overcome this problem by using wethers, as was mentioned in my paper. We shear them to suit ourselves. We shear them when the wool starts to catch on sticks or blackberry. Actually, I have found that the grazing returns from burning standing gorse are just as quick as from cutting first. While I agree that cutting first is a more thorough method, and returns could be a little beter, the problem, with us at any rate, is to get anyone to cut gorse.

Q:: *Could you tell us how you used the tyres to prevent erosion at the site of the bridge?*

A:: We laid the tyres side by side in tiers so that there was a battered bank of tyres. Each tyre was filled with sand or soil as the job proceeded. In the two years since these tyres were installed there have been several quite heavy floods without any sign of erosion near the bridge. I now have the idea of using tyres as a bank for the overflow in a water dam construction.

Q:: *Have you tried spraying gorse with the aid of the helicopter or aeroplane?*

A:: I feel that there is a long way to go before this method is entirely satisfactory. If we could only persuade the manufacturers to put out a better hormone product we might have something of considerable value. But that is the sticky point at present, because such a thorough coverage with the hormone is required to produce results. I am very hopeful, however, that the helicopter will be able to tackle this work in a very

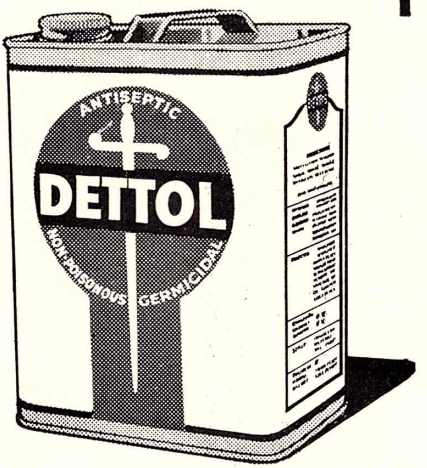
short time. There have been trials with Tiger Moth planes and with the helicopter, and I believe there is not much difference in the results. The people that run the Tiger Moths claim that their work is just as efficient as that done by the helicopter, and vice versa.

Q:: *With regard to the giant discing of gorse, could you give us your views on sowing grass down immediately as opposed to sowing an interim crop of choumoellier or something similar?*

A:: Of course, everything depends on how things fit in with your farm procedure. We have had the bulldozer for only two years. Where an area has been covered in gorse for many years there is a build up in humus, and when the gorse is cleared there is a very fluffy soil. We put one area down to grass more or less straight after bulldozing, but the consolidation was very poor. If the land out of grass can be spared, I would say do so for two years and take two crops off it. In that way much better consolidation would be obtained.

Use this famous antiseptic for your stock

Gentle, safe, reliable and efficient DETTOL is needed on every farm carrying livestock. DETTOL is known and used throughout the world, is gentle on the tenderest tissues (though powerful against germs) and is most agreeable to use.



'DETTOL'
TRADE MARK

THE MODERN ANTISEPTIC

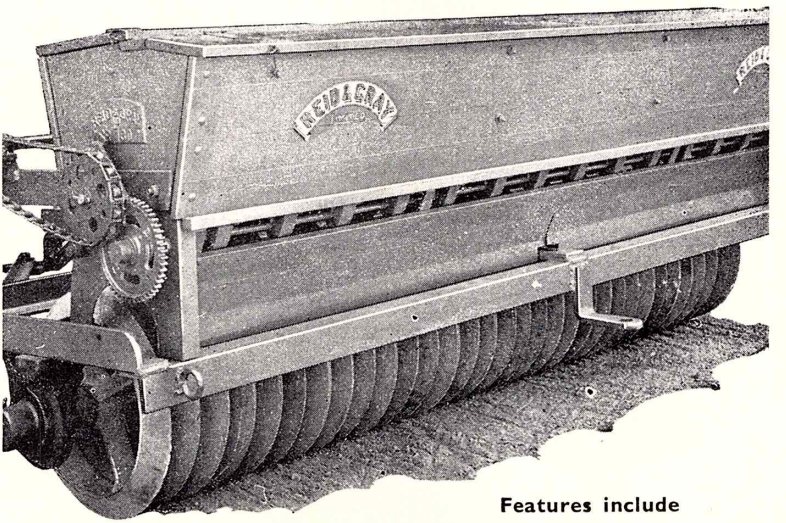
From Chemists, your Veterinary Clubs or Stock and Station Agents.
Reckitt & Colman (N.Z.) Ltd., Pharmaceutical Division, Forth Street, DUNEDIN.

R. & G.'s New and Revolutionary

ROLLER DRILL

'DRILLED SEED GROWS'. . .

Maximum germination with minimum seed sown. Where you would sow 45 lb. of grass seed by broadcasting you sow only 25 lb. by the Roller Drill and get equivalent results. Savings in seed mixtures up to £4 an acre have been achieved. A saving like that actually "pays" for the machine over the first 60/80 acres.



Features include

★ All-steel frame and draw bar.

★ Special 20 in. V pattern rings.

★ Discharge of both seed and manure at rear of rings through wind-screening trough.

★ $2\frac{1}{2}$" heavy duty axle.

★ Unit box construction. Star feed and seeders in line at same intervals.

★ Acreage register standard equipment.

★ Clutch operated from seat of tractor.

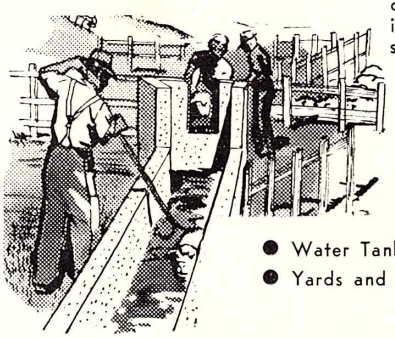
REID & GRAY LTD.

Head Office: BURNSIDE, OTAGO
Branches: INVERCARGILL, GORE, BALCLUTHA

CEMENFORTIS

Waterproofs and Harden's Concrete and Cement Renderings

It is a unique waterproofing and hardening agent which provides a complete non-porous surface when applied to new or old concrete. It combines with the free lime and silica in concrete and provides effective sealing up to a depth of 1 in.



CEMENFORTIS hardens and toughens concrete Races and Shed Floors, stops dusting up and renders them absolutely impervious to water. CEMENFORTIS has been tested and proved over many years by Farmers.

- Water Tanks
- Septic Tanks
- Yards and Races
- Shed Floors
- Cowbails

JOSEPH NATHAN & CO. (N.Z.) LTD.

CARBOLASTIC & SEALTITE

STOPS RUST!
STOPS LEAKS!

It's the World's most universally used Roof Preservative. CARBOLASTIC applied as a waterproof coating, or Sealtite as a plastic patch, adds years of life to any surface. Saves pounds of replacement on corrugated iron and fabric pitched roofs, flashings, spoutings, downpipes, tanks and surfaces of all kinds. CARBOLASTIC is semi-liquid and is applied with a hard bristle brush—Sealtite is a plastic putty and is applied with a trowel.

JOSEPH NATHAN & CO. (N.Z.) LTD.

WELLINGTON AUCKLAND CHRISTCHURCH

Sargoods **BOOTS**

are built to last

THEY GIVE YOU ALL WEATHER PROTECTION,

YEARS OF COMFORTABLE WEAR

AND STAND UP TO THE TOUGHEST WORK.

As comfortable as a pair of slippers—as durable as a tank, Sargoods' boots will keep your feet warm and dry whatever the weather. The superior quality New Zealand leather, and the high standard of skill that go into Sargoods' boots keep them strong and serviceable year after year.

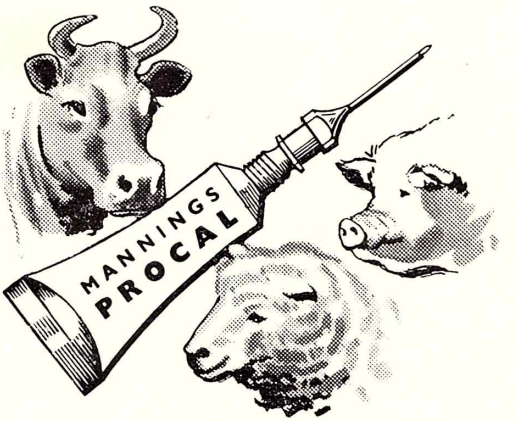
There's a SARGOOD'S boot for every job

DRYFOOT • VANGUARD • TERROR • SPARTAN

YOU CAN RELY ON THEM THEY ARE *Sargoods* PRODUCTS

3.6B

MANNINGS
PROCAL
HYPODERMIC PENICILLIN



THREE STRENGTHS: '100', '500', '1500'
for Bloodpoisoning, Blackleg
and Arthritis in sheep,
Footrot in cows and pigs,
Necrotic Ulcers and
Arthritis in pigs,
and diseases where Penicillin is indicated.

Mannings of Hamilton

THE PROSPECT FOR BEEF

J. D. ORMOND*

I HAVE BEEN INVITED TO TALK about the prospect for beef, and I assume that it is the market prospect you wish me to discuss. We are all aware that the production prospect is one of rapidly expanding output. We are integrating beef cattle into the economy of our fattening farms to a steadily increasing degree. I hope that the recent weakness in the beef market will not discourage anybody from developing this practice, for I believe the prospect for beef remains good. I see no cause for despondency about the future of our beef. I regard the recent setback in prices as a challenge. It is a challenge jointly to producers, exporters, and Government, to our capacity to increase production, to our ingenuity in marketing, and to our skill in trade negotiations for the expansion of our markets and the protection of our chief outlet, in the United Kingdom.

World Prospect for Primary Produce

To get our thinking about the market future into correct perspective, we should consider first the general world prospect for primary produce. Ten years after the war, a recovery and expansion of agricultural output have occurred throughout almost all the Western nations. Almost everywhere agriculture is being protected and subsidized. In some cases, such as the United Kingdom, the growth has been forced.

We have reached a point at which food supplies generally among the Western nations are ample. There are evidences of surplus of some commodities. The pattern of domestic spending, particularly in the United Kingdom, already contains a heavy budget for food. If agriculture among the Western countries is to expand and find an outlet for its surpluses at satisfactory prices, it would seem that living standards and food requirements among the underdeveloped countries will have to improve more quickly than they are doing.

The prospect for meat, however, has features peculiar to itself. Meat has so far escaped the marketing problems of some other commodities. Meat consumption is still rising in various Western countries. Meat imports are at present increasing in Eastern Europe.

While living standards remain high and are increasing, the meat exporting nations enjoy good markets. New Zealand is, of course, the world's greatest meat exporting country from the point of view of both quality and quantity. Almost a quarter of our export produce income is drawn from meat exports, to say nothing of the various by-products of our meat industry. In recent years, as meat producers, we have recognized that, to have a balanced industry, we must expand our supply of beef to supplement our lamb. Our customers in the United Kingdom and elsewhere will trade regularly with us only if

**Chairman, N.Z. Meat Producers' Board, Wellington.*

they can be sure of getting beef as well as lamb and mutton. They should not have to go elsewhere. That way, as any salesman will tell you, you simply send your customer to a competitor.

The Meat Producers Board has, therefore, for some years endeavoured to promote greater production of beef in association with sheep-raising in this country. It is beneficial to the farm economy, as well as to the national economy, that this be done. Exports of quarter beef and veal were more than doubled between 1938 and 1955. The total tonnage of beef and veal exported in 1955 was 96,000 tons. This season the production of beef and veal to date is running 20 per cent. above that of the same period last year.

Beef and veal exports have lately earned about one-fifth of our meat export income, and already constitute about one-quarter of the total export volume of carcase meat and offal. These percentages are being maintained in the presence of large increases in lamb production.

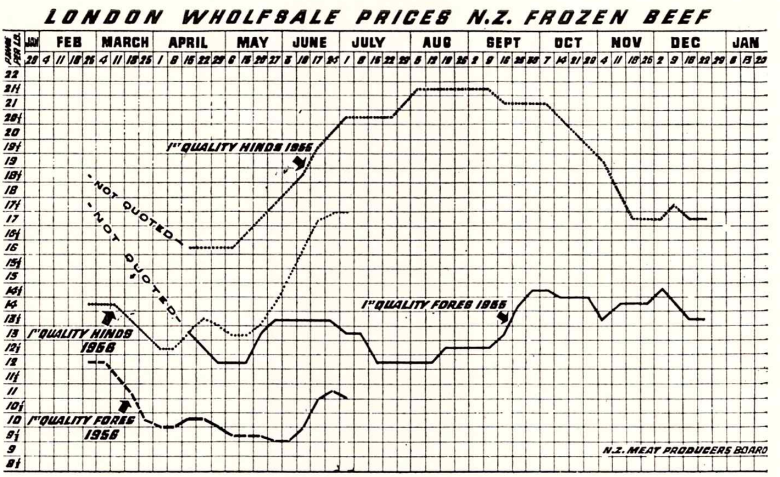
Since pre-war years, beef values have greatly improved. During the bulk purchase era, beef improved its value in proportion to that of lamb, and the end of rationing brought a great demand for beef. At May, 1955, frozen ox hinds were valued at 70 per cent. of the price of lamb, whereas the pre-war percentage was only 57.

No wonder, therefore, that people raising beef have been disagreeably surprised at events since August, 1955. From a high peak in that month there was a sharp decline in beef prices on the United Kingdom market right through to mid-May, 1956. A seasonal dip in values would have been expected during that period, but it was sharply accentuated by one fact—the inrush of supplies from Argentina.

The Argentine beef supply was rapidly converted from frozen back to the traditional chilled beef of pre-war. It began landing at the rate of nearly 20,000 tons a month. Since chilled beef must go promptly into consumption, this great weight of beef depressed prices and caused much frozen beef to be left in store. London wholesale values of New Zealand frozen hinds fell back from a high point of 21½d. per pound in August to 13d. by the first week in May. Much of that decrease was due to the presence of the Argentine chilled beef.

Why this big increase in supply from Argentina? Several reasons may be adduced. In the first place there was a recovery of output after the droughts of 1951-52. An increase in exports was to be expected. Then there was the new incentive which the free market in the United Kingdom offered. On top of those factors there came the sudden change of Government. Today it seems that General Peron was the New Zealand meat-producers' best friend. Immediately upon his departure, the new Government set about a drastic overhaul of the economy of Argentina. They obtained a report from the noted South American economist, Dr. Paul Prebisch, on both short- and long-term measures.

There was an immediate and desperate need to repair the country's balance-of-payments deficiency. Quick moves were made to bring



forward produce for export. Strong incentives were given to producers. The currency was heavily devalued and official cattle prices were raised by 7 per cent. in September, 1955, and then by another 14 per cent. in December, 1955, to offset the higher internal costs which devaluation brought to the beef producer. The National Meat Institute exports the meat through the agency of the traditional meat exporters—the large packing houses. Chilled beef is sold on consignment and has frequently taken the market at prices which cannot have been payable.

To June, 1956, the supply of Argentine beef to the United Kingdom has been at the rate of about 20,000 tons a month, almost two-thirds the pre-war volume. If that is maintained, it will increase the supply from Argentina by about 90,000 tons and put United Kingdom meat consumption back—all other supplies being maintained—to the level of pre-war *per capita* meat consumption.

Argentine Future

The future of the Argentine beef supply and whether this level of exports will be maintained will not be considered here, as the Argentine prospect is the subject of a paper by Dr. H. B. Low (see p. 203). It will be sufficient to say that there is enormous potential for production increase in Argentina. But the level of exports will be dependent on three principal factors:

(1) The rate of increase of the Argentine population and the level of living standards there.

(2) The capacity of the Government of the day to divert meat from local consumption to export.

(3) The relative values of meat and other produce produced in Argentina.

This latter consideration is already important. There has been increasing evidence that the small cattle farmer has found the new grain and oilseeds prices more attractive than those for cattle. This may have been aggravating the present over-supply. Within the last month the Government of Argentina has announced another 20 per cent. increase in the price of young steers. The purpose of this, it is officially stated, is to improve the income of the cattle farmer in relation to that of the crop-raiser. At first thought, this might be considered a move to encourage the immediate flow of meat to the works, but its real purpose, apparently, is to discourage the liquidation of herds.

The true extent to which such liquidation has contributed to the substantial increase in production has yet to be proved. Meanwhile the internal transport system of Argentina is heavily overtaxed with traffic of meat to the works, and the level of exports is limited by the availability of shipping. Although there has been diversion of supplies to the canning works, these in turn have reached a limit of present output. The people are eating beef and veal at close to the pre-war rate. With a population of 19 million, the *per capita* rate of consumption of beef is about 190 lb., compared with 91 lb. in the United States, and 47 lb. in the United Kingdom.

There is therefore a crisis of over-supply in Argentina. The extent to which this will persist cannot yet be accurately predicted. For the present it is not likely that exports to the United Kingdom can substantially increase because of the shipping shortage. But the long-term prospect, for the reasons mentioned, is one of increasing output.

These factors have all been under discussion in the monthly surveys issued since 1955 by the Market Information Service of the N.Z. Meat Producers Board, and already widely published. A continuing study of Argentine trends is being made and the Board is being kept closely informed. A member of the Board, A. Baker, is shortly to make a visit to South America to establish a closer personal contact.

United Kingdom Market

Against the background of rising export output from Argentina, New Zealand, and to a lesser extent Australia, I should now like to refer to the United Kingdom market. It is well-known that Britain is the only large meat-importing market in the world. We depend on this market to take about 85 per cent. of all our meat. Our future lies there for some years ahead at least, and we must plan accordingly. What is the prospect of beef in that market? I believe it to be better than it has been represented by many people.

Look at the figures: In 1938, the United Kingdom was eating 1,200,000 tons of beef per year. Of this, 600,000 tons came from home production and 600,000 from imports. By 1955 home production had risen to 700,000 tons, and imports were only 350,000, making a total supply of 1,050,000 tons for a United Kingdom population which had increased by 7 per cent. Put simply, the

consumption of beef and veal in 1955 was at 47 lb. per person, compared with 55 lb. in 1938. In the intervening years, beef and veal and lamb consumption had lost ground to pork.

But there is a great deal of room for more beef and lamb and mutton in the daily meals and snacks of the people of Britain. The overall meat consumption is back almost to pre-war level, but that is almost entirely because of increased pork output, the result largely of the artificial stimulus of subsidy. In 1956 the British Government has reduced the guarantees to the pig industry and is concentrating on the attempt to produce more beef. It is officially recognized that there is room for much more beef.

It may be asked if that is, in fact, the case. What of the accumulation of frozen beef in store at the start of this year? But I would say that the rate of consumption of all kinds of beef has still a considerable distance to go. In the first quarter of 1956, production and imports of beef were only 18,000 tons, or about 6 per cent. up from the first quarter of 1955, notwithstanding the great inflow of Argentine beef.

The United Kingdom can take all she is likely to get from Argentina this year at the present rate, without exceeding pre-war *per capita* beef consumption. Even if Argentina adheres to her present schedule of 20,000 tons a month right through the year, and supplies from other sources, including a slightly improved home output, are not significantly changed, the total of beef and veal in 1956 may be still about 150,000 tons short of the requirement to bring the people's average consumption of beef and veal back to the 1938 level.

United Kingdom Prices

The thing that may have to give, and in fact has given, is the price.

But I would not say that even that has been drastically lowered for good. We have just been in the midst of the seasonal period of heavy supply and declining price, which was apparent in almost every pre-war year of private trading. The market this year received more meat in the first quarter than it could dispose of. Today, however, as we had anticipated, stocks have been moving more readily, and the graph of frozen beef prices took a sharp upward turn in May, 1956.

It has to be realized, also, that 1955 was the first full year of return to private trading and abolition of rationing. Meat values took a sharp leap upward. Some settling down was inevitable, on return to a keenly competitive market, particularly on a market affected by the present tightening of credit and the drive toward lower food prices.

I would repeat, however, that there is room for substantially more beef in the United Kingdom, as well as for lamb and mutton. There is a limit to the short-term supply from Argentina, and in the longer-term supply there are uncertain factors about Argentine beef. We believe, furthermore, that Britain will eventually agree not to

depart from the spirit of imperial preference as laid down at Ottawa a quarter of a century ago, and which we are bearing closely in mind again today.

Other Markets

Meanwhile, by way of the figures and facts mentioned, I should like to leave you with a more optimistic view of the future than many have painted. Turning from the United Kingdom to other markets the prospect is encouraging. Few realize that just on 30 per cent. of our beef and veal exports last year, the first full year of private trading, went to markets outside the United Kingdom. This season there is again a lively demand from the Continent and from the West Indies. Over 10,000 tons of beef and veal were sold last year to Europe through the ports of Germany, the Netherlands, and Belgium, 6,000 tons to Italy, and 1,200 tons to Spain. Russia took 2,400 tons of beef, as well as a large quantity of mutton. There has been a useful market for boneless beef and veal, particularly from our Italian customers. All this, of course, takes a weight of beef off the United Kingdom market.

Marketing System

At this point it should be made quite clear that the N.Z. Meat Producers Board is not in control of the marketing of meat. The Board promotes New Zealand meat in the United Kingdom by way of intensive and continuous advertising and publicity campaigns. It facilitates, by negotiation, the opening of the way for New Zealand exports in the United Kingdom and elsewhere. It supervises and allots such shipping space as is available. But it does not at any stage own the meat or control its marketing. That should be made abundantly clear, because there are people who imagine the Board is in commerce in meat. It is important to note that, whereas New Zealand wool is marketed by open auction, and dairy produce by a single trading commission, meat exports are handled a third way.

Meat exports are wholly in the hands of private traders. There have been criticisms of their policies and their results from time to time in the marketing of New Zealand meat, and close attention is paid to these factors. By and large, the system applying in our industry is capable of better result, but it is more practical in operation than complete industry ownership would be. Instead of relying upon the initiative of one central authority, our meat is being pushed in many parts of the world by the joint initiative of numerous exporters—all with strong incentives and their own special knowledge of their trade.

Some of these sales of beef to other markets have been enterprisingly promoted by the special activity of individual "explorers" among the exporters. Indeed we are fortunate that they are able to operate to the extent they can. In Australia there is constant complaint because, under their 15-year agreement with Britain, they are limited

in the amount they can send to other markets. The Australian Meat Board has been under constant fire because Australian meat cannot go in sufficient quantity to other markets, and their deficiency payments scheme is impossible to operate satisfactorily. They are negotiating now to get present arrangements modified, and they envy us our position.

I think I have said enough to demonstrate why we are reasonably confident about the prospect for beef. We believe further that, in the long-term, the world demand for beef is going to expand, that although the United Kingdom population may be comparatively static, population increases elsewhere, notably in the Americas, and to a lesser extent in Australia, will expand requirements and open new opportunities for meat-exporting countries.

Increased Production

Grant, therefore, that a policy of continuing increase in production of our beef is desirable and necessary. What, then, is our domestic prospect? The beef producer is doing his part with spectacular results, as has already been noted.

It is worth noting here that the output of all meats for export is currently about 18 per cent. above the figure for the same date in 1954. That sets us well on the way to the 60 per cent. increase which has been generally regarded as necessary to sustain our own meat supply and our export income for a population of three million in twenty-five years' time.

There has been for some years past a wide, general, and intelligent application of the new farming techniques developed from the years of research into New Zealand production problems. Under the stimulus of rising population and good prices there has also been a breaking in of much new land and a rehabilitation of old, reverted holdings. In the field of increased production the Meat Board has contributed substantially, by making use of a small proportion of the industry's reserve funds for investment, both short- and longer-term, in aids to greater farm output. The Board has invested large sums in the Tauranga and East Coast fertilizer projects and is about to invest another million pounds for the same purpose in Southland. It is determined to increase the supply of fertilizer available to the farmer and maintain the competitive element in prices.

This policy is necessary also to enable the production of sufficient fertilizer to employ the country's fleet of aerial topdressing aircraft. By investing a quarter of a million pounds in short-term loans with good security, the Meat Board has enabled aerial topdressing firms to convert to modern planes, and has assured the farmer of a service which is now very widely employed and must already have played a leading part in promoting increased production. Our aerial farming progress leads the world, and we are proud of it.

It must be agreed that the producer, by whatever means, is getting magnificent production results today. And that is not only true of

quantity but of quality. Our chilled beef, for instance, has a longer journey to Britain than the South American meat, but it is generally accepted as being better quality meat. Our lamb is, of course, always at a premium, thanks to even quality and grading and constant sales promotion.

Transport

It is unsatisfactory to have to state that our efforts as producers to increase and improve output are not enough. We are hampered on every hand by lack of adequate transport, both external and internal. Our internal transport system is full of jams and bottlenecks. A lot of our time is devoted to attempts to get the parties concerned to bring transport facilities into line with the immediate requirements of an expanding meat trade—to say nothing of our enormous potential requirements.

We must have the best brains available turned to the priority job of making our transport capable of handling modern demands upon it. I should here like to pay tribute to the energy and capacity which the present Minister of Railways (Hon. J. K. McAlpine) is bringing to his very onerous job. But he alone cannot get the necessary results. We have made representations to the Government, and a Cabinet Committee has been established. We are expecting that this matter will receive urgent treatment. Our livelihood as meat producers, together with the good health of that large sector of the economy supported by meat exports, demands that there shall be no avoidable impediment to the free flow of meat to markets overseas.

That, of course, brings us to shipping. We have to note that the British shipping firms who enjoy our trade are being asked to carry a heavily increased volume of New Zealand meat across the world. They are called upon also to supply special accommodation for our chilled beef. They are optimistic about their prospects this year of getting a good clearance of the season's meat. But it remains painfully true that we are still far from having enough shipping space at the right time and the right place. This fact has cost us hundreds of thousands of pounds in sales not made to the best advantage.

This trade is constant. It is always there for the shipowners. It ought not much longer be necessary for them to plead shortage of shipping space. Both within and beyond New Zealand we are entitled to expect the co-operation of all concerned in handling and transporting meat. Long-term planning is essential. We have the estimates of the Director-General of Agriculture (E. J. Fawcett) upon which to base that planning. These estimates make it abundantly clear that we are in danger of getting worse bottlenecks than we already have. But I cannot believe the Government could be so short-sighted as to postpone major measures.

These are problems that fairly directly concern the whole community. Today we are in the grip of a credit squeeze. We are told there is not enough capital for expansion of industry and services. Short of reducing our living standards, greater production for export

is the only way to break free of the squeeze. The meat-producing industry is earning continually increasing returns and its part in maintaining national income from exports has been demonstrated. This year, so far, realizations from exports are up 20 per cent. from last year.

Provided prices do not fall drastically below present levels, producers, by still further increasing their output for export, can maintain and enlarge the national export income. Only in that way can the country's economic health and prosperity be maintained. And if spending is wisely restrained, the credit squeeze can be put out of mind.

However, the farmer can achieve this result only if his product is efficiently and promptly carried to market when required, and if the Government will take bold action to restrain his costs. So far the Government has talked much about curbing costs, but it has not yet achieved impressive results.

In time of easing prices, farm costs need constant watching. Producers know that fact well enough. The fullest co-operation of all industries servicing the farmer is required, and beyond that again, we need action by the Government to ensure that we do not lose in high costs what we have won by higher output.

Ottawa and GATT

Another major matter in which we must rely upon effective Government action is the safeguard of our trading rights in the United Kingdom market.

Today there are influences at work in London and elsewhere trying to write off imperial preference as out-of-date. These people are hardly less dangerous than those who are trying to break down the British Commonwealth by more violent means.

New Zealand will be highly vulnerable if effective imperial preference is not retained. This country depends on its meat exports for a large part of its national income. We are the largest meat exporting country in the world; but our only large market is the United Kingdom and if we allow our traditional rights there to be whittled away, we shall have only ourselves to blame for the consequences.

A disastrous slump brought an effective, practical quota system into being in 1932. The Ottawa agreement in that year saved us from even worse disaster than did occur. The flood of foreign supplies had forced many home and Commonwealth farmers off their land. It was agreed among home and Commonwealth producer organizations that, in times of over-supply, there should be preference in the British meat market, with the home producer ranking first, the Commonwealth producer next, and after them anybody else.

In that way new life was given to the home and Commonwealth livestock industries. Under that scheme the Commonwealth producers were given assurance of an increasing share of the British market.

In return, we for our part gave British manufacturers substantial protection in New Zealand and they have enjoyed a heavy margin of

preference for a quarter of a century in a New Zealand market which has enormously enlarged through the years. New Zealand has had the privilege of free entry for our meat to the United Kingdom market, but in all the years since 1938 there has been a shortage of meat in Britain and we have not had occasion to need full application of imperial preference. The benefits have been largely paper benefits.

Today, we are just beginning to see a very real need of imperial preference again, as an insurance for our future. But today we also see people trying to break down the Ottawa principle. They are striking at the very roots of Commonwealth economic co-operation. For us to permit people to get away with the destruction of imperial preference would be sheer madness. I use this strong language because we must have the importance of this matter clearly established in people's minds, particularly in the mind of the Government.

You can well understand the concern of farmers' organizations when it was discovered that under GATT (the General Agreement on Trade and Tariffs) the New Zealand Government of that day agreed to a clause which sought to write a death warrant for the Ottawa system of imperial preference. That clause provided for the eventual elimination of the Ottawa quota preferences which had protected New Zealand meat in the United Kingdom market. Yet New Zealand agreed to this without the Meat Producers Board being informed. When the Board raised this question in August, 1955, the Government agreed to issue a White Paper containing the story of GATT. Until then the full facts had been unpublished in this country. People were pretending GATT did not mean the things it said, and were trying to persuade us we could not understand it. That was shocking irresponsibility. In future our producers' representatives must have the opportunity to watch the interests of their industry and to be consulted on negotiations affecting them.

Of course I agree the principle of GATT is attractive. We can all subscribe to the notion of freer world trade. In some ways New Zealand would stand to benefit by it, and may already have done so. But GATT involves economic disarmament for New Zealand; and nobody wants to disarm alone, as in effect we would do. As the largest meat-exporting nation in the world, we would be the country most directly hurt if imperial preference is allowed to go overboard. Other nations have been given waivers and exemptions under GATT to protect their agricultural industries. If necessary, so should we. You may be told that GATT has not actually eliminated imperial preference—it only provides for the *eventual* elimination of the Ottawa quota preferences. But today Britain has set about a policy which is clearly designed to fall in with GATT—a policy of elimination of quotas in favour of tariffs, which cannot give us the protection we once had and still desire.

This move towards the writing down of imperial preference in the meat industry does not come from the United Kingdom producer. It appears to come from certain interests in London, in what is known

as "the City." The home producer is protected by his State guarantees and is not so directly aware of fluctuations in the value of his produce.

Canadian and Australian farmers are today in a somewhat different position from that of 1932. They have both become much more industrialized nations. New Zealand appears to stand somewhat alone and be more vulnerable than others. We cannot afford to sit by and wait for the large countries of the Commonwealth to hammer these things out. We have our own economic lives to protect and there can be no reason whatever for delay in arguing our case in London. We need to have a completely new look at our trading relationship to consider not only our place in the United Kingdom meat market but the tariff preference enjoyed by British goods coming into New Zealand.

These are urgent issues. Their national importance must be recognized. We cannot afford to be hesitant about them. To make doubly clear the principles involved, the resolutions moved by Sir Reginald Dorman-Smith at the Empire Producers' Conference in Sydney in 1938 are quoted below. Sir Reginald was at that time president of the National Farmers' Union of Great Britain. He moved:

> (1) That this Conference takes note of the great satisfaction with which the primary producers of the United Kingdom originally received the adumbration by Mr. Stanley Bruce, High Commissioner for Australia in London, of the principle that the Mother country should give first place in her home market to the home producer, and second place to the produce of the overseas Dominions, and that foreign countries should take third place as suppliers of the Mother country's requirements.
> That this Conference welcomes the fact that the Ottawa Economic Agreements recognized the validity of that order of preference, and affirms the need for exhausting every means of giving practical effect to it.
>
> (2) That this Conference recognizes that it is the duty of the organized primary producers of the Empire to do everything possible to develop intra-Imperial trade, bearing in mind in relation to the market in the United Kingdom for foodstuffs:
>
> (a) The necessity that the home farmer should have a remunerative market for his produce which will enable him to maintain the volume and character of his output at a level consistent with the full maintenance of the fertility of his land and of the well-being of the rural population;
>
> (b) The limitations of absorptive capacity imposed by:
> (i) Existing purchasing power, and
> (ii) The probable decline of population in the near future;
>
> (c) The bearing of national defence requirements upon the situation; and
>
> (d) The extent to which the overseas Dominions may deem it economically desirable to develop their secondary industries.

(3) That this Conference accepts the necessity of maintaining an economic level of prices for primary products in the United Kingdom market whether home produced or imported, and, having noted with satisfaction the operation of the International Beef Conference and the Empire Beef Council, is of the opinion that, where control of imports is necessary to secure the end in view, similar machinery should be set up to regulate supplies of other primary products coming on to the United Kingdom market from all sources, including foreign countries, with due regard to the order of preference accepted by the Ottawa Economic Conference and endorsed by this Conference.

(4) That this Conference, having regard to the common interest in securing the expansion of primary production within the Empire, desires to impress upon His Majesty's Government in the United Kingdom, and His Majesty's Government in all the overseas Dominions, the importance of taking into immediate consideration the desirability of conducting on an Empire basis commercial treaty negotiations having for their objective the expansion of foreign markets for Empire primary products.

(5) Realizing that all parts of the British Empire are vitally concerned with the question of defence, which will depend ultimately on the financial strength of the industries and the peoples of the British Commonwealth of Nations, this Conference is convinced that action in the foregoing direction must come from Empire producers themselves in order to safeguard their predominant interest in the Empire markets, and by effecting a complete revision of the present methods of organization on an Empire economic and co-operative basis to facilitate a comprehensive and continuous review of the position by Empire producers' representatives themselves, whose business it would be to advise, and confer with, Empire Governments from time to time on behalf of all producing interests concerned.

In their final form, the resolutions were slightly different, but the principle of the International Beef Conference and the Empire Beef Council was accepted by the United Kingdom producer. Under this system the Empire Beef Council decided what beef the United Kingdom market could absorb.

It was agreed that these imports of beef should come from within the Empire, and after that the outsider was consulted in the International Beef Conference and given his share of the market that remained. That was true imperial preference.

I do not want to alarm you, however, about our immediate future in the United Kingdom market. I believe that with intelligent and forceful negotiation of trade agreements, and maintenance of the high quality of our beef, the prospect remains good.

Minimum Prices

When the sharp fall in beef prices developed, it became apparent by March-April, 1956, that the minimum price scheme in New

Zealand for export meat would have to be brought into operation. That had not been generally expected, but experience has amply proved the wisdom of the meat producers in having the scheme instituted in time, and in endorsing the principles upon which it operates. This is not a scheme designed to bolster the industry at an artificial level of prices. It is intended to cushion the effect of overseas price movements upon the farmers', and therefore the people's, income and the national economy. It is directly related week by week to the realities of the market, yet enables us to protect the farmer from the full effect of sudden disturbances in overseas market values.

For many years meat producers were inclined to be rather sceptical when they were told that the major proportion of the funds standing to the credit of the Meat Industry Reserve Account would be used to cushion the effect of a sudden or drastic fall in prices of export meat. They were rather prone to adopt a "that-will-be-the-day" attitude.

Therefore, it will be all the more pleasing to them, although of course they regret the necessity, that the scheme of providing minimum prices for export meat has in fact operated to keep their returns from beef up to the minimum provided by the Meat Export Prices Act, 1955.

The provisions of the empowering legislation and the method of administration are well known, and will not be repeated here, but one or two aspects of the current situation that have been causing concern should be referred to.

First, it should be explained that simplicity of administration was absolutely essential, but it was no easy matter to achieve this in providing for an industry of such a type.

The scheme as at present operating, and it is operating successfully, is one that is equitable and reasonably free of anomalies. It could not be operated successfully without the co-operation of the freezing companies and exporters. I am pleased to state that this assistance is readily forthcoming.

I doubt if any scheme of this kind and magnitude could function without anomalies, and I will be the first to admit that some will occur in the present scheme, but I feel they will be of a minor nature and over a period may tend to balance out.

A case occurred this year in which, because of insufficient chilled beef shipping space, a certain amount of beef of chiller quality was not able to be shipped in chilled form, and did not qualify under the Act for the higher chilled beef deficiency payment. Some operators were paying the chilled beef schedule for this meat, despite the fact that it was eventually shipped in frozen form, and a certain amount of criticism developed when it was announced that only the lower frozen beef deficiency payment applied.

To those producers who were disappointed at this decision I should like to point out that, in being paid the chilled beef schedule for this

beef, which was actually shipped and sold as frozen beef, they were receiving something over and above that to which they were entitled. The operators who paid the additional price—no doubt as an honourable gesture—would undoubtedly lose fairly heavily on the transaction.

Then again the question also arose of the drop in the price of heifer beef as against ox beef. Many producers felt that the heifer beef should be supported up to the minimum price of the ox beef. The committee's decision was that heifer beef was a grade of beef within one of the classes set out in the Act and that it could not be individually supported.

In using a predominant weight grade as the basis for arriving at a common deficiency payment for all grades in one class of meat, an anomaly arises when the price of the basic grade does not move, but the price of another grade within the same class of meat does move. Over a period this may tend to balance itself out.

Another point I should emphasize is that, although the Minimum Prices Committee will generally use the assessed f.o.b. value of the requisite weight grade in the current fat stock schedule as the basis for making deficiency payments, it is not called upon by the legislation to do so. It can, in fact, assess the f.o.b. value in any manner it desires. In other words, the Prices Committee is not called upon to put the rubber stamp seal of authority on all or any of the fat stock schedule prices issued by the operators.

To those who are apt to criticize the scheme—and I feel sure they are a minority of producers—I would point out that this is the first year of operation of a rather complex undertaking and it was always understood that the only way it could be improved was through the process of bitter experience.

The Prices Committee is open-minded and anomalies in the scheme which have become apparent this year will be given a thorough examination before next season's minimum prices are gazetted.

Just one final point. The Meat Export Prices Committee set up under the Meat Export Prices Act, 1955, is the sole arbiter of whether or not a deficiency payment should be made and of the amount thereof. The Meat Board has no jurisdiction in the matter (except to the extent that it has two representatives on the Committee). The Board does, however, administer the scheme and provide the necessary data for the information of the Minimum Prices Committee.

As to next season's minimum prices, the only thing I can say—and it is purely a personal opinion—is that I do not expect the pattern to vary greatly from that experienced this season.

* * *

I hope that by now I have drawn a fairly accurate picture of the prospect for beef, and of the work the Meat Board is doing in the development of production, transport, marketing, and minimum prices. Finally, I would repeat that producers are doing a magnificent

job, and that, given the chance to develop their output without the hindrances of increasing costs and inadequate transport, they will produce more miracles out of the bag.

We had to expect that, under conditions of highly competitive trade, some of the bloom would fade from earlier beef prices. However, the stability of our beef industry is not in danger at present, nor need it be if we handle our problems with vigour and imagination.

What then is the task before us?

As I see it, the Board has to tackle four things:

(1) It must tackle the question of the provision of adequate facilities for the processing, treatment, and transport of our meat in New Zealand and abroad.

(2) It must see that we are kept fully informed on developments overseas, and that we are consulted before trade agreements are made. I think it was a mistake that New Zealand agreed to Annex A of GATT—but the farmers were not consulted on this matter.

(3) It must fight for the retention of the principle of imperial preference, and force our Government to bargain for it.

(4) It must make every effort to explore the chances of new markets and work towards their establishment.

DISCUSSION

Q:: *The last time Mr. Ormond spoke at Massey he encouraged us to increase beef supplies. What of that now?*

A:: I said in my address that New Zealand had done wonders in increasing her production. If production had not been increased this country would be a very poor one. Our standard of living has been built up by increasing production, and whether it is breeding beef from dairy cows or from stud herds, it all makes up that whole picture. We have meat today to sell to Europe as well as to the United Kingdom. I still think it is sound to produce more beef. Produce beef so that the sellers in our market of lamb and mutton can have beef or veal to sell with it. That is sound business. I still say that you should not be discouraged by your prices. Fight for better prices. Fight for better rights—every country does that. Fight for your place on the British market. Produce more goods and we will be a wealthier country.

Q:: *What is your attitude towards establishing a purchasing organization on the London market?*

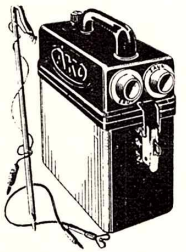
A:: I think you will recall that I supported a purchasing organization which I considered we should have established in 1952. When I came back to New Zealand with this view I was regarded as a young radical rascal.

The British traders regarded me very coldly indeed. But those days are gone. Today we have established a free market and the co-operatives have come into being, through which farmers can kill on their own account and sell to London through the Fatstock Marketing Corporation, an organization brought into being by the Farmers' Union of Great Britain. That is a step that has come out of wanting freedom from the big operators. Today we have in existence a system by which you can sell your meat through operators, or you can sell it on your own account to co-operatives. We have advanced, I consider, a great deal.

Q:: *Do you agree that the present grading is of benefit to the meat trade? For example, for cow beef today, the store cows put into the works this year brought £15, while the old cull cows brought £18. Are we going to be encouraged to sell our beef before it is in prime condition or not?*

A:: The truth of that question is this: if Australia were on a free market, as we are, we would not have been able to sell those older cows, because the market for old cow beef is one that Australia has previously had. Orders came from Europe for a certain class of meat at a good price, and the operators went in for it. The result was the figures you quoted. That is competition. If we do not want that, well, do not let us take that market.

AKO ELECTRIC FENCERS



For Labour Saving, Economy, Flexibility

AKO Electric Fencers have been designed for use with either temporary or permanent installations. To ensure a LONG and RELIABLE life, weather resistive materials have been used throughout....

★ The movement is simple and uses the time tested "flywheel" principle. The unit is a reliable precision engineered article that will give a long life of trouble-free operation.

AKO Electric Fencers operate from a 6 volt WET or DRY Battery

The Battery Case takes a Standard New Zealand made Wet Battery or four No. 6 Eveready Dry Batteries.

NOTE THESE FEATURES:

1. Effective shock.
2. Extremely light battery drain.
3. Precision engineered throughout.
4. Reliable.
5. Safe.
6. Full 2-year guarantee.
7. Complete with earth prod, fence lead and clip, battery leads and clips.
8. Portable and self-contained.

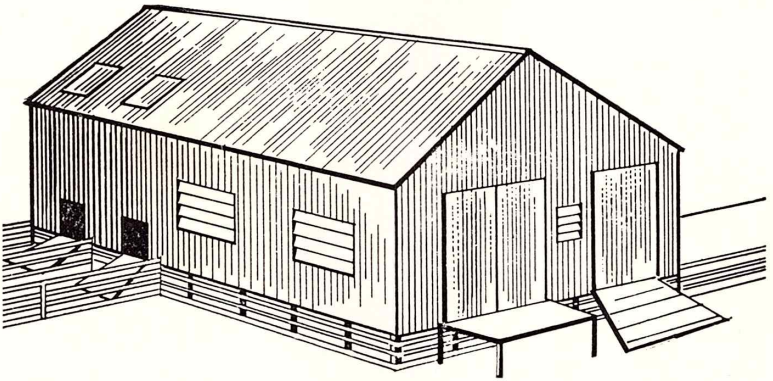
PRICE £14/19/6

See them at your Dealer

Factory Representative: Hooker & Company, Auckland. Sole New Zealand Distributors: Hamer Electrical Co. Limited, Christchurch.

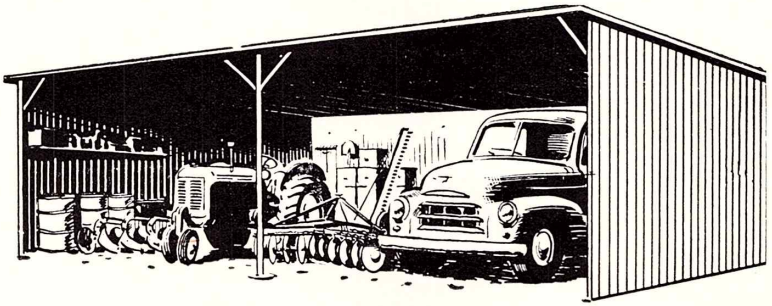
SHEEP FARMERS . . .

HERE'S HOW "MAJOR" STEEL BUILDINGS *PAY FOR THEMSELVES!*



'MAJOR' STEEL WOOLSHEDS

PAY FOR THEMSELVES because scientifically designed layouts enable you to handle more sheep—faster. Quickly erected, these sheds last a lifetime and can easily be enlarged if required. Plans and specifications available for interior layout—save time, worry, money.



'MAJOR' STEEL IMPLEMENT SHEDS

PAY FOR THEMSELVES by preventing deterioration in valuable implements, equipment and farm tools. Permanent structures, "Major" Steel Implement Sheds will last a lifetime and provide storage for countless items.

Technical advice available if required

'MAJOR' STEEL PRODUCTS LTD.

P.O. Box 2653, Wellington

Trustee Management

IN STRIDE WITH PROGRESS!

With over 30 years of active Farm Management and Administration to its credit, The Guardian Trust has the ability and experience to manage your farm on modern, progressive lines, and provide expert personal supervision, for the full benefit of your dependants.

It is in the best interests of your family to make a Will and to appoint The Guardian Trust your Executor and Trustee.

Your nearest Guardian Trust manager below will gladly give you details or you can write for free booklet "A Farmer's Will".

THE GUARDIAN TRUST

AND EXECUTORS CO. OF N.Z. LTD.

(Empowered by special Act of Parliament 1883)

PERMANENCE GT & SECURITY

HEAD OFFICE:

South British Insurance Building,
Shortland Street, Auckland.

Gen. Manager: E. BISSETT. Asst. Gen. Mgr.: D. L. McKAY.

Branches at Wellington, Napier, Hawera, Palmerston North, Hamilton, Gisborne, Christchurch. Agencies throughout N.Z

2.6

Order NOW *your requirements of*

"NITRO-PLUS"

and boost early Spring grass

To ensure plentiful Spring feed, order stocks immediately from your Fertilizer Merchant.

IMPERIAL CHEMICAL INDUSTRIES (N.Z.) LTD.

ICI

P.O. Box 900 Auckland

P.O. Box 1592 Wellington

P.O. Box 1486 Christchurch

FACT
NOT FICTION

The Super-Sure-Grip by Goodyear is the world's first choice Tractor Tyre

It is a fact that the Super-Sure-Grip by Goodyear is the world's first choice in tractor tyres. This overwhelming preference is the result of years of farm experience which has proved that its straight-bar o-p-e-n c-e-n-t-r-e tread—pioneered by Goodyear and found only in the Super-Sure-Grip—gives the 'greatest pull on earth.' Farmers everywhere know that its 'wedge-grip' action means savings in work, time, fuel and money. In ever increasing numbers they are letting this *fact* decide which tractor tyre they should fit. Why not let their vote of confidence in Goodyear design, workmanship and performance be *your* guide to the right choice in tractor tyres.

GOODYEAR GB5-55-5

SUPER-SURE-GRIP TRACTOR TYRES

RECENT ECONOMIC CHANGES IN ARGENTINA

WITH SPECIAL REFERENCE TO BEEF EXPORTS

H. B. LOW*

THE MORE ATTRACTIVE PRICES that New Zealand has been receiving for export beef in the last few years, in spite of the United Kingdom's growing subsidised production, have been due in part at least to the fact that supplies from Argentina have been so low.

We might feel inclined to wish the Argentines well when their growing population is able to consume more beef per head than ever before. That suits us nicely as beef producers. It seems to denote prosperity in Argentina also. But it has become increasingly obvious for more than a year now that the low beef supplies from Argentina were not the natural result of healthy economic development but rather the opposite. Even before President Peron was expelled last September, meat exports had begun to increase and the new Government has already made strenuous efforts to expand them further.

We cannot even begin to try to make a guess as to what further expansion there may be in beef exports without having a look at the Argentine scene in general—and that is my reason for talking of many other things besides beef.

It will be remembered that the Ottawa Agreement of 1932 restricted Argentine meat exports to the U.K. That was a considerable blow to the Argentine economy. We need first to have a look at Argentine before the war. There was little industry, no coal, a little oil, very few minerals, and the country depended overwhelmingly on the export of grain crops and linseed, and meat and wool. In the export figures crops were even more important than meat. The exports of grains and linseed often fluctuated very greatly because of recurrent droughts. Argentina and other Latin American countries chafed against their economic dependence on the rest of the world because they were sellers of primary produce liable to heavy price fluctuations and importers of the more stable-priced manufactured goods. A considerable part even of their fuel had to be imported all the way from Britain or Europe. It may be remembered how in the war years huge quantities of grain were burnt as fuel.

Power was in the hands of a few, the big landowners, and above all in the armed forces, who in 1931 had pushed out the Radical Government that had been in office since 1916. The army was to do the same again in 1943—and again in 1955. The agricultural workers were poor but sheltered, living under well-intentioned but feudalist conditions. Social reforms were obviously needed but the hunger for them was largely unsatisfied.

**Senior Lecturer in Agricultural Economics, Massey Agricultural College, Palmerston North.*

Improved Labour Organization

One of the members of the new Government in 1943 was a certain Colonel Peron who had in the early years of the war been an observer with Mussolini's forces. With large Italian and German elements in the population there was considerable sympathy with the Axis powers. Peron hoped for long for an Axis victory. But he actually made his name as Minister of Labour, by using his powers to improve wages and other working conditions. His activities on these lines were so forceful that the right-wing demanded and got his resignation, but he came back very quickly. He had strong support among the slaughtermen's union, and egged on by his mistress, Eva Duarte, they came out in a forceful demonstration in the streets of Buenos Aires. These were the men, many of them wearing only blood-stained trousers, whom his enemies derided as "the shirtless ones." Soon afterwards, as Labour candidate for the presidency, he was elected, married Eva, and started off to transform his country.

The wartime aspirations of the world were for freedom and equality—freedom from interference by other countries. To Peron this meant freedom from having foreign countries running the railways, tramways, gas works, meat works. He set himself to build up Argentine industry and to nationalize the foreign investments in his country. Meanwhile his wife started to organize trade unions, not so much for their benefit, although the workers did benefit in long-delayed reforms, as for the benefit of the Perons. The taunt that Peron and his wife were supported by the "shirtless ones" was turned into a very effective piece of propaganda to show that the Perons' main care would be the industrial employment and good wages and conditions for industrial workers. The constantly rising wages were made possible by, and in turn led to, inflation. Agricultural workers flocked to the cities to enjoy the higher real income. Because the big estate holders were his enemies, Peron deliberately sought to break their power. Big estates were to be broken up if they were not properly productive, but it appears that this was, in fact, done only as a by-product of a few cases of confiscation from his enemies.

But the hampering of farm production was due not only to the flow of farm workers into new industrial employment. Even worse was the effect of low prices in discouraging production. Peron set up the Institute for the Promotion of Trade (known by its Spanish initials as I.A.P.I. or Yappy). This was designed to force sellers of produce to sell to I.A.P.I. at prices fixed as low as possible, while it resold (abroad mainly) at the much higher prices that ruled after the war while the seller's market was at its best. The profits were supposed to go to the building up of new industries giving employment to Peron supporters under the first five-year plan. That fitted nicely with Argentine aspirations to industrialize and with the kind of support the Perons had won for themselves by their combination of autocracy and calculated appeal to the masses. The obvious sufferers were the farmers. Farm production failed to expand and in some cases declined.

What the country needed was heavy export of what the country already produced, to enable the necessary capital imports to be bought to set up new industries. If exports would not suffice, foreign loans would have been the answer. What Peron did, in fact, was to pay back capital to other countries when he should have borrowed it. The £150 millions paid to Britain to buy out the British-owned railways is a case in point. Then, when overseas funds disappeared, he made agreements with individual countries to buy imports on deferred payment terms. In total he bought far more than the country could pay for; at the same time as he undermined its ability to pay with exports. He needed loans from other countries but he did his best to put obstacles in the way of the earnings on the borrowed capital and the foreign investments being remitted to the overseas lenders.

For a while things seemed, however, to be going his way. Wages were continually pushed up and working conditions were improved for his many supporters. The world needed Argentine products badly. They fetched huge prices. But he seemed to have little economic sense to balance his very shrewd notions of how to buy support. This was not only a considerable part of his own undoing, but it led his whole country into chaos. If you were a business man you could get permission to import by graft. As a business man you could not trust the puppet judges to protect you if you protested against the levy made on your business for Eva's social welfare schemes. When wages were raised but productivity fell, you had better pay and hope to recoup yourself in higher prices. Real wages were certainly raised, but since production per head for the whole country rose scarcely at all most of the gains went to one section simply at the expense of others. Peron and his henchmen became millionaires.

If the wealth which the Government was putting its hands on had been all used to set up strong new industries, develop the oil resources, maintain the railways and expand the basic needs for electric power and a steel industry, the great cost of dislocation might have seemed worth the paying. But industrialization went ahead only most haltingly. Some of the moves were the right sort for a country trying to set up a better balanced economic system for itself—but only a few.

The Need for Transport

One of the basic needs of a country as big as Argentina—ten times the area of New Zealand—is a good transport system. Since the railway system was nationalized in 1947, it has fallen badly into disrepair and huge sums will have to be spent on it urgently. At present one of the reasons for the present export drive is the cost of imported oil—£60 million a year is spent by a country that could quite quickly become self-sufficient from the oil fields east of the Andes.

From this can perhaps be sensed how urgent is the need for farm exports. They are virtually the only way of paying off debts already

incurred. These debts must be met if other people are to be willing to lend Argentina—not money, but the real things which the country wants to maintain and expand its economy. Or, if the capital is not to be got by loan, there is all the more need to export what Argentina can now export to buy the capital equipment in exchange. This is also the burden of Dr. Prebisch's now famous report on the condition of his country presented very shortly after Peron had departed.

The State of Argentine Farming

Let us have a closer look now at the farming side. The agreement signed with the U.K. in February, 1948, promised 400,000 tons of meat a year—something over a quarter of the U.K. meat ration. Next year's agreement hopefully mentioned 300,000 tons, and the following year 230,000 tons. But even this was not fulfilled and at different times in the next year or two meat exports were entirely suspended and Argentina herself had meat shortages and meatless days.

There were two reasons for this—the low prices offered by I.A.P.I. to the farmers, and the drought of 1950 to 1952 which cut the wheat crop to less than half its normal size and caused heavy cattle losses. Meanwhile, booming money wages had encouraged a rise in local consumption of meat per head. Moreover, population was growing at a very rapid rate—from 13½ million prewar to 19.1 million in 1955. The meat exports were pinched out between the large domestic consumption and the drastically lowered total production.

The results can be seen in cattle numbers. The complete accuracy of these figures may well be doubted but they are suggestive.

1936-40 (average)	33.8	million head
1949 (?)	41	,, ,,
1950-52 drought reduced them to	27	,, ,,
1955 climbed to	44	,, ,,

Alongside this we can put the estimates of total beef production and consumption from the Argentine National Meat Institute.

	Total Production (000 tons)	Consumption in Argentina (000 tons)	(Per head)	Exports (000 tons)	Per cent.
1935-39 (ave.)	1,667	1,052	170 lb.	616	37
1948-51 (ave.)	1,971	1,565	206	406	21
1950	2,044	1,615	209	429	21
1951	1,879	1,623	205	256	14
1952	1,788	1,513	186	275	15
1953	1,766	1,535	185	230	13
1954	1,795	1,555	185	240	13
1955	1,940(?)	1,600(?)	190	340(?)	—
1956	—	—	—	420(?)	—

One fact which immediately emerges is that exports became, under Peron, a small, chancy, volatile remainder left over from home consumption.

It will be noticed that home consumption was very high indeed. Home consumption *per head* may be expected to fall. The same unattractive prices for meat that followed I.A.P.I. control and the artificial discouragement to export by the exchange rate meant that meat was cheap for home consumption. Moreover Peron's wage policies raised urban incomes. Both encouraged meat consumption.

What may happen now that the exchange rate has been altered? Just a word about the exchange rate. The produce that sold for £1 in the latter days of Peron would be turned into 14 pesos at the non-preferential rate for meat exports. Today £1 paid by the U.K. turns into just over 50 pesos—a much more realistic rate but in fact rather too high to be applied suddenly. The impact of the change of exchange rates is being lessened by making a levy on export proceeds of 10 to 25 per cent., to be used to finance technical help to farming and to help keep down the cost of essential imports used by agriculture and industry. Even so the apparent boost to prices of meat given by the altered exchange rate would seem to be to more than double them. This, however, greatly overstates the rise since, in fact, I.A.P.I. was forced to pay more for meat than the old exchange rate suggested. At any rate it can be said that the boost to meat prices in pesos will have been considerable. But, of course, costs have gone up too, and imports have become more expensive.

When Peron went, his successors started to pull I.A.P.I. to pieces —but a form of Government price has remained. These are apparently fixed prices, although recently it was announced that for grains there would be minimum prices which the Government will pay if the market does not offer more.

Changing Price Structure

Early in the new regime crop prices were raised further and faster than meat prices and some commentators have seen in the rising meat slaughter the temporary effect of a good many farmers going out of beef and into crops. In other words the high killings include, in their view, some capital stock.

Just at the beginning of this month (June, 1956) there was a statement by the Minister of Agriculture and Livestock about whether grain prices had been so high relative to livestock prices that some farmers were going out of cattle and thereby raising the meat supply temporarily as they liquidated their herds. His reply to that contention was that three years ago all farm prices were too low but cattle were relatively the more attractive. He said that some farmers who had fattened steers previously were attracted into breeding, not only unbalancing the structure of cattle raising but doing so excessively on bank loans and getting themselves into financial difficulties. In December, 1955, grain prices were raised more than cattle prices. In May, 1956, prices of young steers for export were pushed up 20 per cent.

But between these two dates the swing away from cattle was said to have begun. However, the Minister was right in saying that cattle prices had been higher relative to wheat than the usual long-term relationship.

Nevertheless, the comment of the *Review of the River Plate* shows that, even though the official prices of livestock for slaughter may be suitably attractive to producers, a good many farmers sell in the open market, without this official support, at unattractive prices. Evidently they, mostly smaller farmers, have been going out of cattle and into grain. This weakness of the open market prices for livestock may be a temporary phase, with extra animals including some breeding stock being sold off but prices being depressed by inability to ship the meat away.

What is quite clear is that even informed commentators on the spot are fairly confused and that controversy is acute.

Possible Levels of Argentine Beef Exports

I am impressed by the fact that beef exports started to shoot up in August even before Peron went, and at the usual off-season. Of course, that also coincided with the end of the United Kingdom Ministry of Food contract and Argentine exporters would naturally make the earliest possible move to adapt to and get into the new free market. With cattle numbers apparently about one-third above pre-war and population about 42 per cent. up, we might make some guesses at the possible level of exports of beef. Our main difficulty is in knowing just how much reliance can be put on the reported livestock numbers. Another census of cattle and other livestock will probably be made shortly. There is plenty of evidence of a real fall in cattle numbers round about 1951, but evidently the Peron government felt that some cattle men were reporting fewer than their real holdings. On February 4, 1954, a special resolution of the Argentine National Meat Institute required all those owning or holding 80 or more adult steers to declare them within ten days.

To guess first at the level of exports that may be possible within the next year or two, I will start by having a look at the extreme assumptions in both production and home consumption. I shall assume that production is not likely quickly to exceed the 2,044,000 tons reported in 1950, when it was apparently boosted by some slaughter of capital stock. That is the highest ever reported in the past.

Recent 1955 consumption was at a level of 190 lb. per head for 19.1 million people. That is probably the present upper limit. The new regime has a narrower base of support than Peron had 10 years ago and it will be most unwilling to allow town employment to fall —that would anger the trade unions; and it has already moved to raise wages and salaries 10 per cent. But with the higher prices of meat brought about by the exchange rate at its new level, beef consumption within Argentina is likely to fall a bit. In a somewhat different situation in Australia, the higher relative price of meat cut

home consumption quite enough to be noticed. However, town meat prices were subsidized by Peron. His successors are wondering whether they dare remove the subsidy. But if they do, higher prices might drive down consumption to its pre-war level of 170 lb. per head. However, that means quite a lot more consumption than pre-war since the population has risen so rapidly.

My estimates are then:

Total production	....	2,044,000 tons (the 1950 level)
High consumption	....	1,620,000 tons (190 lb. per head)
Low consumption	....	1,450,000 tons (170 lb. per head)

The maximum export surplus is therefore 600,000 tons—almost up to pre-war level, and the likely minimum is 424,000 tons.

The lower figure is about what appears to be the present export level, which has already had its effect in recent months. I submit that, if this turned out to be the export level of the next year, it would cause much less disturbance to the market than it has caused in this first year of private trade, which has been so marked by uncertainty. Moreover, I would expect some of the recent moves to widen trade to shift some of the selling pressure from the U.K. market. Argentina has just recently signed an agreement in Paris with its largest European trading partners to give up the narrow bi-lateral trade agreements with their special currency arrangements and use transferable sterling in multi-lateral trade. These European countries are all owed money by Argentina and several of them are willing to buy beef.

Of the two levels of export I have chosen (both of them based on the maximum likely total output) I think the lower one much the most likely in the near future because transport, especially shipping, seems to be a bottle neck, and killing space is also some limitation.

What about the next ten years? A country using very little fertilizer, suffering every now and again from droughts, grasshoppers, foot and mouth disease, and having only the smallest beginnings of a Department of Agriculture will find expansion somewhat hampered. Back in 1952, the second five-year plan mentioned hopefully the four experimental stations in livestock genetics that were to be set up, the eleven artificial breeding centres and the central breeding station. I hope these things will be set up. In the last ten years, 1945-55, the population rose 3.6 millions. It is likely to rise that much again in the next ten years. Another 3,600,000 people will raise the home beef consumption by 270,000 tons even if they eat only the lowest recorded amount per head.

This is a very big prospective cut in the increased production which they will be all-out to get. In the long run I would expect their expansion to be immense. But the population of South America as a whole looks like growing so big so fast that I feel their meat exports will mostly go to markets that just do not exist at present.

The interesting thing to watch in the next few months will be the local prices of meat in the Argentine. They have been reasonably low

for two reasons—the shipping difficulties have kept the local free market weak and meat cheap; where the big cities draw their meat from the big works where the higher official prices are obtained by farmers, the Government has paid a subsidy to keep down meat cost to the consumers.

When shipping improves, the effect of the exchange alteration will be to raise the local market prices towards export parity. Then it will be increasingly costly to keep down prices to the consumer by means of a subsidy. The authorities will be torn between the desire to eliminate the subsidy which, on only part of the consumption, is now costing £20 million a year, and on the other hand their natural dislike of causing a rise in the cost of living to those who were Peron's main supporters. My guess is that they may feel forced to subsidize meat prices and hence hold up local consumption. But they may feel strong enough to do the wiser thing.

Since the Argentine annual beef consumption has to fall by only 10 lb. a head in about 190 lb. to release 85,000 tons more for export, I am led to two conclusions. The first is that there is likely to remain a good deal of fluctuation, a good deal of uncertainty, about the total beef export from Argentina. The second is that you ought to, even if you do not, realize why I am an unwilling prophet.

DISCUSSION

Q:: *What is the level of beef consumption in other than the Argentine?*

A:: Beef consumption in the United States is 91 lb. per head; in Australia 67 lb. per head; in Britain at present 48 lb. per head. My memory may not be reliable, but those are the orders of magnitude. Consequently, Argentine beef consumption is so very high that if, for example, Argentina becomes more industrialized—and it is becoming so—city people would tend to eat less meat, I think, and especially if the price goes up. When the price of meat went up in Australia, consumption fell quite noticeably. If the new exchange rate is allowed to have its effect, as it will when there is no shipping bottleneck, so that farmers can sell at export equivalent, and if it becomes impossible to retain the high subsidy on meat, meat consumption per head in Argentina is likely to go down. As I said, it has only to go down from 190 to 180 lb. per head, and 85,000 tons more beef are immediately released for export.

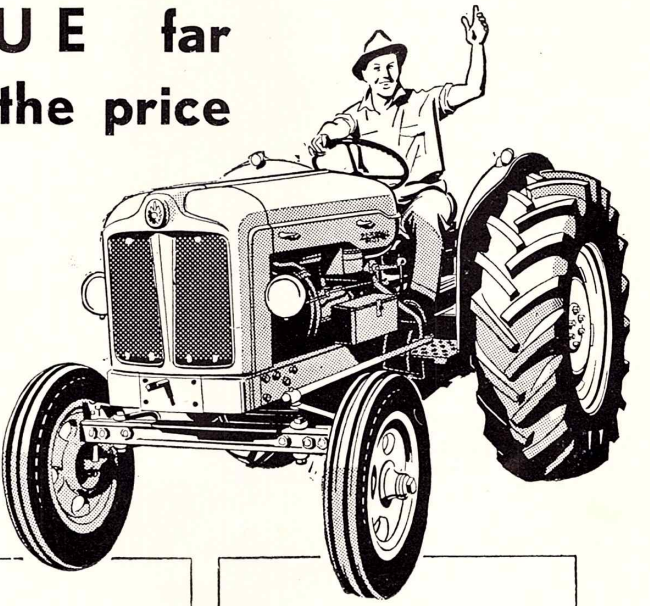
Q:: *If the present low price for cattle were reflected in New Zealand butchers' shops, how much do you think our beef consumption would go up?*

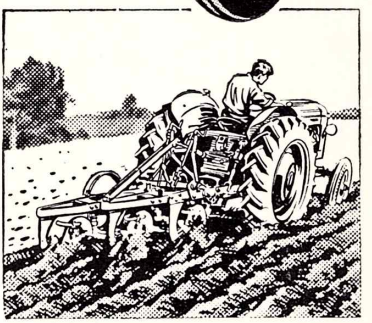
A:: We have not had such an experiment made, but very obviously it should be made. An idea of what happens in our type of country can perhaps be gained from Australia where there has been a marked rise in their prices over the last few years, which showed quite clearly in the figures of lower consumption per head. I would expect our consumption to go up a little with lower prices, but our figures are not of the same order of magnitude as those in countries like Argentina.

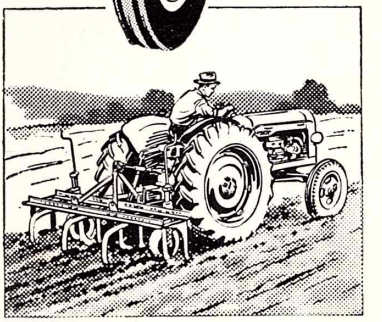
Q:: *Could you give the figures for our own consumption?*

A:: In New Zealand we consume annually 215 lb. of meat per head. Of this total, just over 100 lb. per head is beef.

VALUE far above the price







Versatile, Powerful, Economical

FORDSON MAJOR

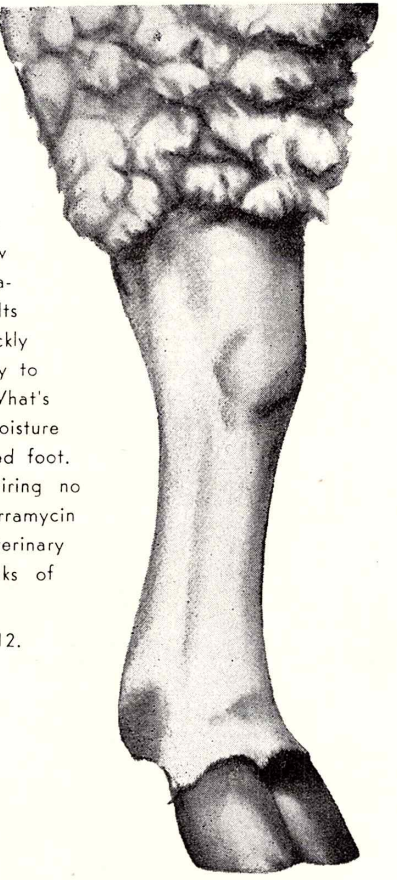
PETROL and DIESEL MODELS

6 FORWARD SPEEDS, 2 REVERSE provide the right gear for every farming job at the most ECONOMICAL speed. Ask your Ford Dealer to TEST DRIVE the Fordson Major on your farm. No obligation!

FORD MOTOR COMPANY OF NEW ZEALAND LIMITED LOWER HUTT

A report* of a recent trial, published in the May issue of the British Veterinary Journal, proves conclusively that the application of Terramycin Topical Ointment, with Polymyxin B, is the most effective, most economical treatment for common foot-rot in sheep. Costing only a few pence per sheep per application, Terramycin Topical Ointment effectively halts the progress of the disease more quickly than a tincture because it is less likely to suffer dilution by water or mud. What's more, it acts as a barrier between moisture and the sensitive tissues of the infected foot. Unspillable, easily portable and requiring no brush or instrument for application, Terramycin Topical Ointment is the practical Veterinary Surgeon's prescription in all outbreaks of common foot-rot.

*British Veterinary Journal (1955) III 212.



Cure Footrot in Sheep

at low cost per animal with . . .

Terramycin

BRAND OF OXYTETRACYCLINE

TOPICAL OINTMENT

(with Polymyxin B. sulphate)

PROVED MORE EFFECTIVE, MORE ECONOMICAL THAN TINCTURES

Pfizer

Established 1849
World's Largest Producer of Antibiotics

Sole Distributors:
A. M. SATTERTHWAITE & CO. LTD.
Auckland, Hamilton,
Hastings, Wellington,
Christchurch, Dunedin.

GRAM FOR GRAM TERRAMYCIN IS UNEXCELLED AMONG BROAD SPECTRUM ANTIBIOTICS

DEVELOPMENTS IN THE USE OF AIRCRAFT AS AN AID TO FARMING

AIRSTRIPS AND THEIR INSTALLATIONS ..... *A. D. Simpson* 215

THE USE OF THE HELICOPTER IN WEED AND PEST CONTROL ..... *E. C. S. Little* 220

CROP SPRAYING AND DUSTING AND THE HORMONE TREATMENT OF WEEDS ..... *P. S. Ferens* 230

For Successful Dipping use

CLEANSO BRAND

SHEEP DIPS THIS SEASON

CLEANSO GAMMEXANE FLUID DIP WITH ALDRIN

This dip is deadly in the destruction of keds and lice and will also give protection against fly infestation for a period of 3-5 months.

CLEANSO ALL PURPOSE FLUID ALDRIN DIP

A new dip which provides maximum killing power for the destruction of keds and lice and will also prevent fly infestation for periods up to 30 weeks.

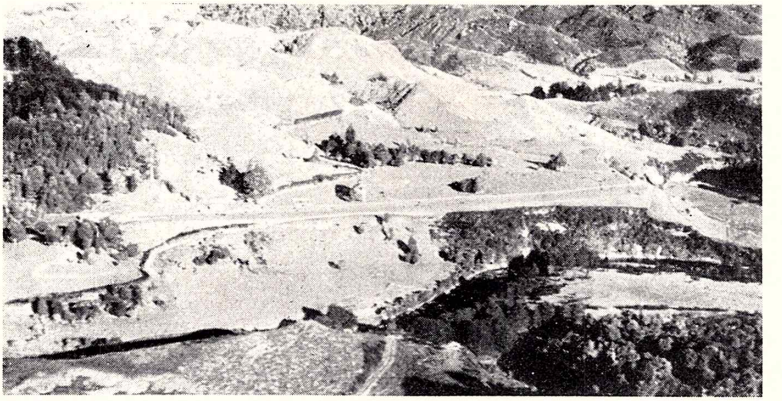
CLEANSO SPECIAL BLOOM DIP

Gives a lustre to the wool and so improves the appearance and handling qualities. Specially recommended for stud breeders.

CLEANSO BRAND SHEEP DIPS ARE MANUFACTURED IN NEW ZEALAND TO SUIT N.Z. CONDITIONS BY

FARMERS INDUSTRIES LIMITED

TAUPO QUAY, WANGANUI, AND ARE AVAILABLE FROM ALL STOCK AGENTS.



An example of a present-day airstrip in steep hill country—the Ruatiti 600 yd. airstrip.

AIRSTRIPS
AND THEIR INSTALLATIONS

A. D. SIMPSON*

AERIAL WORK COMPANIES WERE FIRST FORMED in New Zealand to cater for the sowing of superphosphate from the air and initially the Tiger Moth was the only type of aircraft used for distribution.

In the 6½ years that have passed since the industry was established, many changes have taken place. The Tiger Moth has given way to larger ½ ton types of aircraft, which has meant a considerably changed outlook on the operation of aerial topdressing.

Originally airstrips were formed on hill tops and ridges to avoid loaded climb with Tiger Moths. These strips, however, subjected the aircraft to wind conditions which considerably curtailed their activities and, although turn-round time was less because the aircraft were generally above the sowing level, utilization was also decreased because of unsuitable wind condition. This resulted in additional costs to the farmer as loading gangs were very often kept waiting for suitable flying conditions.

The hill top strips had other restrictions, such as long, steep, winding clay tracks over which the superphosphate was carted, and a limited strip length, generally about 250 to 300 yards. Thus, when the larger ½ ton aircraft appeared many of the older strips were of no use.

In the main, the ½ ton types used today can handle the loaded climb, and, as most of the ridge top strips are limited in extension, the strips have been brought down to valley bottoms, river flats, etc.,

**Manager, Feilding Branch, Rural Aviation Limited, Feilding.*

where larger flat areas are available and the strip site is usually closer to a road or has an easier truck approach. As a result of experience with Beaver and Cessna aircraft over the last 4½ years and 3 years respectively, the writer's company has recommended strips built on the principle of 450 yd. minimum flat, 400 yd. minimum downhill length, a minimum width of 1½ chains, and loading areas of 2 chains square.

Bulk Superphosphate

With the arrival of the heavier aircraft, the company undertook sowing of bulk super., as farm labour was at a premium and as some difficulty was experienced in starting jobs when lambing, shearing, docking, etc., were in progress. Lack of appreciation of bulk handling methods and lack of suitable mobile bulk-loading equipment provided a very poor opening chapter in the bulk super. story. On a number of occasions, such factors as temporary bin storage, green super., loading of sheds with tip trucks wherein each successive truck rode up over the previous load to tip, and using bulldozers to push super. into sheds caused the use of gelignite and breakdown of equipment through the super. being hard and consolidated. Some farmers were put off by these difficulties and many still are biased against bulk super., but the story is very different today.

The original temporary bins made of car case sides and the old escalator type of loader did a good job in demonstrating the possibilities there were in aerial sowing of bulk super.

Farmers who saw the future in bulk stuck to it and have built proper bulk storage sheds on their strips. The sheds vary widely in design and materials, but the most important thing of all is the loading of the super. into the shed so that it can be freely unloaded at sowing time.

This can be done a number of ways. The simplest method is to use a bank adjacent to the strip. The shed is built against the bank, and the super. is then tipped from the bank into the shed.

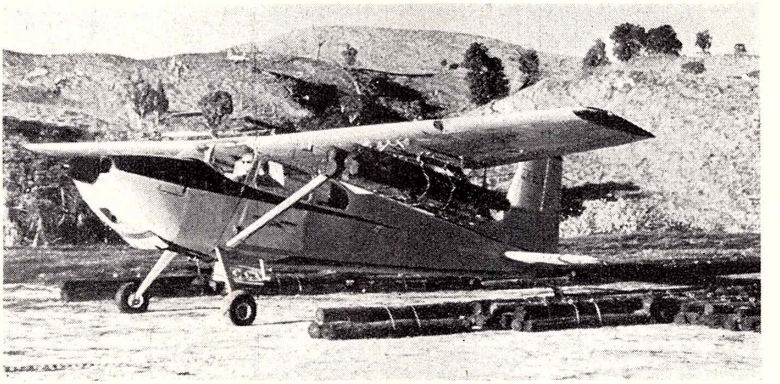
For strip level sheds the following methods are in use:

Short wheel-base dump-trucks dumping at an average height of 4 ft.

Front-end tractor loaders putting super. up to 8 to 9 ft.

Escalator loaders elevating to 8 to 9 ft.

Stationary winch with dog clutch and a wire rope passing through a pulley at the top of the back wall of the shed, with a scoop on the end of the wire rope. This method is suitable for lower roofed sheds in which dump trucks cannot operate; the super. is dumped at the shed entrance and then promoted to the back of the shed by the winch and scoop. The method can also be used in a higher shed to gain a greater depth of super. than that given by dump-trucks. The scoop operator has to walk over the super. in gaining the extra height, but this is not detrimental to the storage.



Cessna 180 about to take off with 15 treated larch poles weighing approximately 750 lb.

On many farms, the loading of the sheds is being done by the carrier, leaving the farmer completely free of any additional work at that time. Then, when aerial topdressers arrive to sow the super., all they require is five minutes of the farmer's time for him to say where the super. is to be sown and they do the whole job themselves.

It is true that sheds on airstrips cost money. An average type of shed that will hold 100 tons will today cost £350 to £400, but this amount can be recoverable in three years after changing to bulk from bags. The saving is in purchase price, bulk *v.* bags ex works, and airstrip loading charges, less bag rebate (if jute) and bulk unloading charge at rail. If 300 tons are put through in the first year, the shed can be paid for that year.

While on costs, one or two ways in which money can be saved on airstrips might be mentioned.

On an hourly charge-out rate—and all companies are working on that system—a few seconds saved every circuit can save a few shillings in the cost per ton.

Storage sheds or loading ramps of the right type in the correct place ensure the minimum amount of time for the loading equipment to cover the distance between super. and aircraft. The operations manager of the company being dealt with will be only too pleased to discuss that problem.

Maximum strip length and width available, 400 yd. and better, will avoid strain on the pilot and allow him to take off and land freely.

A strip surface over which a car can be driven freely at 45 m.p.h. will allow a quicker, easier take-off. Rough, restricted strips increase airframe maintenance and pilot fatigue. The accident may not happen on the strip but fatigue may cause it in the sowing area. No one wants accidents and they keep insurance premiums up—which farmers pay for.

Post Dropping

The dropping of fencing and building materials by air has been brought about by the increased carrying capacity in the hill country and the resultant need for greater pasture control. The pack-horse is now a thing of the past and so a cheap and workable method of transporting fencing materials into the steep hill country was sought.

Some years ago posts were dropped from an Auster aircraft in the South Island and a Fox Moth in the North Island. They were carried internally and, as this method has its problems in limiting control of the drop, the results were not as good as desired.

Two years ago the writer's company started trials with a Cessna 180 aircraft fitted under the wings with bomb racks which could be selected individually or in salvo and fired electrically from the cockpit. Ground tests with posts were carried out to check that the racks and circuits were working and then flying trials were made.

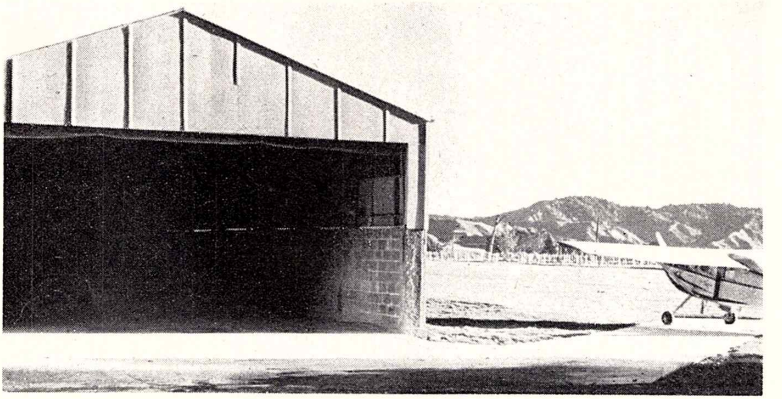
Silver pine posts were the first to be used and it was found that they broke very readily. However, after a series of test drops from various heights and at different airspeeds a technique was developed which, although it did not entirely eliminate breakage, reduced it to a minimum.

The next step was to try posts of various types and evaluate the breakage rate. It was found that treated larch and hardwood posts were almost unbreakable, while totara and silver pine were unsuitable as the breakage rate was too high to be economical.

Several methods of bundling were tried. Tying with No. 8 fencing wire was settled on as the best method, and over 18 months ago the company started dropping commercially. The bundling method has since been changed, a Gerrard bundling machine now being used. This machine ties the bundles with steel tape and draws the posts into a very tight bundle. There are two main advantages with this machine. When using No. 8 wire, the wire was twitched up tight with fencing pliers and was overstrained and weakened at the knot, so that on contact with the ground the bundle would immediately break open and the posts would fly. With the steel tape, the knot end is an overlapping of the tape in a seal. When the bundle hits the ground, the initial shock is taken in the seal and then the bundle opens up, confining the posts to a smaller area. The other advantage lies in the fewer man-hours required to make up bundles.

The aircraft has a permissible payload of 800 lb. slung under the wings, but in the main loads of approximately 650 lb. in posts are being carried as the wind resistance or drag area, plus weight, has an effect on the aircraft performance. This load allows 12 hardwood posts or 16 to 20 treated larch to be carried at a time.

The charge-out rate for the aircraft is £25 per hour. On a job 1½ to 2 miles from the airstrip with 800 to 1,000 ft. of climb to the dropping area, approximately 120 hardwood posts per hour (4s. 2d.



Bulk shed on an airstrip at Raetihi, shared by twenty farmers. Loading equipment is on concrete during the whole operation.

per post) or approximately 180 to 200 treated larch (2s. 6d. to 2s. 9d. per post) can be put out.

Battens, wood or steel, iron standards, droppers, Hunter fencing, and barbed wire, are all perfectly satisfactory. More careful handling is required with No. 8 wire but it can be dropped very successfully.

In trials carried out at Porirua, the wire was put on to reels made out of paint drums. This method was quite satisfactory, except that the man-hours involved in making up the reels were too great. The present method is to make up four bales of wire into one bundle and suspend a bundle on a horizontal plane from each pair of bomb racks. The wire is dropped flat on to a specially selected area, where the ground is even and sloping towards the line of flight of the aircraft. This method has been found very successful.

Accuracy of dropping is remarkable, with at present an average error of approximately 30 ft. In one job at Dannevirke recently, 400 posts were dropped in two hours and one man spent only three hours in splitting the bundles and laying the 400 posts out on the line.

In building materials, several drops of huts have been made on Mt. Egmont. These were free drops—that is, parachutes were not used—and they were very successful. In one operation, we dropped precut studs, rafters, floor joists, corrugated iron, shingle, cement—everything for the shed—and also supplies—rifles, ammunition, kerosene stove, kerosene, groceries, etc.—and the only thing that was broken was a packet of peas.

It has been estimated that the immediate requirement of posts in the hill country is some 10 million. With almost two years' experience and the results of the many thousands of posts that have been dropped, the company now feels that the pack-horse which will take the fencing materials into the hills is the aircraft.

[photo.: Bell Aircraft Corp.

Spraying a crop with insecticide.

THE USE OF THE HELICOPTER IN WEED AND PEST CONTROL

E. C. S. LITTLE*

Introduction

IT WILL BE A LONG TIME before helicopters are treated with indifference. As an astonishing exhibition of scientific ingenuity in overcoming gravity, they do not fail to fascinate most people. The interest of agriculturists in these machines, however, is in their possible value as tools to take some of the hard work out of farming and also to increase production and profits.

This paper is intended to summarize the facts, as known to the writer, of the results of 18 months' work in New Zealand of one machine and to make speculations as to the future. Much of the information has been derived from the early association of my company, Imperial Chemical Industries (N.Z.) Ltd., with Helicopter Services Ltd. As part of the assistance given in the early stages of the development of this venture, I was detailed to help in the testing of the equipment and assessing the best way to deal with the different types of work offering.

Just recently work has been completed on the initial testing of the new machine acquired by Helicopter Services Ltd.—the Bell 47B.

How a Helicopter Flies

A helicopter flies by rotating its wings and thus creating lift—as opposed to a conventional aircraft which gets lift by dragging fixed

**Technical Service Officer, Imperial Chemical Industries (N.Z) Limited, Wellington.*

wings at an angle through the air by propellers. The helicopter principle enables the plane to rise vertically, and, by varying the pitch, or angle, of the rotors, to move in any direction at any speed up to the maximum (about 80 to 100 m.p.h.).

Flying in this way needs more power per unit of payload than does a fixed-wing plane. With present types of machines, it also involves much greater mechanical complexity and this also increases the cost of the helicopter per unit of payload. Helicopters are thus dear to buy and dear to fly. They also require special pilot skill for the intricate type of flying demanded for agricultural work.

What have they to offer to offset these serious obstacles to their use?

The Helicopter's Usefulness for Agricultural Work

The helicopter does not require an airfield. Any reasonably horizontal patch of ground half the size of a tennis court is enough provided:

(a) It is not close to hazards such as trees or poles.

(b) It is slightly elevated, giving the plane a clear run from take-off point into the wind for about 50 yd., preferably with the ground falling away from the take-off position. (Though the helicopter takes off vertically, when fully loaded it is easier to move off into the wind and from a slight rise.) With the skid undercarriage it does not matter if the ground is wet, muddy, or uneven, as long as it is not actually a bog.

It can fly slowly and thus follow contours and keep close to the ground with safety.

All farmers and other practical men can see the implications of these most important points. Summarized they are:

(a) An expensive airstrip (which, even when made, can be temporarily useless to fixed-wing planes after prolonged bad weather) is not needed.

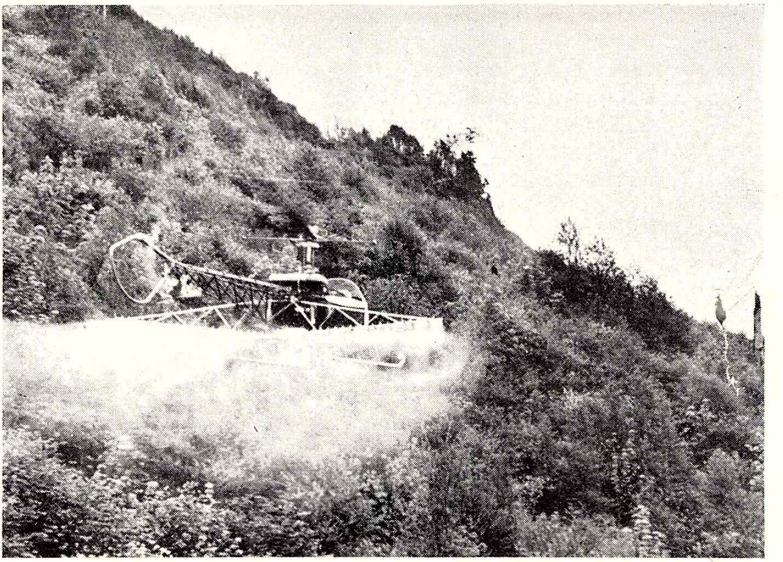
(b) Loads can be picked up by the helicopter from the boundary or within the target, thus minimizing "dead" flying to and from the target.

(c) Accuracy of application is obviously going to be much greater with a plane flying slowly (25 m.p.h.) than one which is forced to fly at least three times as fast.

(d) Spot treatment of small targets is possible using the minimum of material as opposed to a faster moving plane which would be forced to expend a lot of material over a large area to make sure of including the small target.

(e) Recognition of the target is simpler for the pilot. This reduces the number of times your material goes over the fence into the neighbour's.

(f) Loss by drift, with all its ancillary dangers of possible claims in the case of toxic materials, is greatly reduced



[photo.: Weyerhaeuser Timber Co.

More controlled spraying of hillsides is possible with a helicopter than with a fixed-wing aircraft.

because of the lower level at which the spray can be released.

Helicopters are becoming more and more efficient as flying machines. Continuous and rapid improvements are narrowing the margin between their lifting capacity and reliability compared with fixed-wing planes. Under the generally hilly conditions of New Zealand, where most agricultural targets are generally complex (as compared with larger, flatter countries like extensive parts of Australia and the U.S.A.), the helicopter's points just described make it obviously a tool to be taken seriously. It also means that farmers must take a number of factors into consideration when deciding whether a given job should be done by one type of plane or another.

Types of Helicopters

Several military helicopters have made brief visits to New Zealand —Sikorskys, Bells, and a Sycamore. The first helicopter imported to and owned in New Zealand (by Helicopter Services Ltd.) was a Hiller 12B. This venture was largely due to the initiative and enterprise of O. G. James. As mentioned above, the company has now also obtained a Bell 47G.

(i) *The Hiller 12B,* which first flew in January 1955, was primarily bought for agricultural employment—mainly spraying and dusting of weedkillers, insecticides, and other chemicals. It has a two-bladed rotor and a stressed metal fuselage. Though an excellent flying machine, its use for agricultural purposes has been somewhat restricted

by the modifications imposed by military requirements. It thus has had its load-carrying capacity limited by extra gear and heavier equipment than would normally be fitted to a purely agricultural machine.

(ii) *The Bell 47G*, though also used for military purposes (the U.S. Navy icebreaker *Atka* had two), has many features which appear to give it considerable advantages over the Hiller 12B. One of the most important is load-carrying capacity—500 lb. as opposed to 400 lb. for the Hiller. It also has better designed and more efficient spray equipment. For these reasons Helicopter Services Ltd. decided to switch from Hillers to Bells—the change being made easier by the fact that they have the same engine.

(iii) *Sikorskys* have helicopters fitted for spraying—for example, the Westland Dragon Fly.

(iv) *The Bristol Sycamore* is to be demonstrated in New Zealand shortly and it is understood that its use for agriculture is being considered.

Research on helicopter design is active and continuous and there is no doubt that more efficient and cheaper types may be available soon.

Agricultural Equipment Fitted to Hiller 12B and Bell 47G

Spraying Gear

Tanks are located close to the centre of gravity and are interconnected. The Hiller has a hydraulically-operated pump and the Bell a direct drive (an advantage which saves a lot of weight). The boom on the Hiller can carry 33 jets but modifications were made to double this capacity. The Bell has fittings for 40 vertical jets and 20 horizontal. The filtering arrangements on both machines are poor and in consequence there has been a lot of trouble from blocked jets. In America they do not seem to need to draw their water from ditches, cattle troughs, etc., as is often necessary here—perhaps they have hydrants in every paddock!

Jets are made by Spraying Systems Ltd. and have an instantaneous shut-off device which prevents dripping from the boom. This device, however, can be made ineffective by dirt as the sealing washer is lifted off its seat. With the number of jet sizes available, a wide range of rates per acre and droplet sizes is possible. Each plane delivers a swath of about 60 ft. width when flying at about 10 ft. above the target. This is approximately twice the length of the boom. At 25 m.p.h., the planes thus cover about 3 acres per minute. The maximum delivery of spray per acre at this speed is about 10 gal. for the Hiller and 14 gal. for the Bell. For most tasks this is ample, but for certain jobs more than one pass is needed to deliver sufficient spray to wet the target adequately.

Though a helicopter can hover or fly at very slow speeds for continuous work, it is safer and less tiring for the pilot if a speed of at least 25 m.p.h. is maintained. If engine failure occurs this speed gives the pilot more chance in making a safe landing. This point was well demonstrated at Wairoa recently when the Hiller suffered a

sudden engine stoppage and the pilot was able to make a landing and emerge unscathed. The helicopter was, however, seriously damaged.

DUSTING GEAR

The Hiller arrived with complete dusting gear, but this has yet to be tried out.

AEROSOL, OR FOGGING, GEAR

This gear can be fitted to both machines.

Testing and Calibration

Because the pump is driven from the main engine it is easy to test the rate of delivery from different jet arrangements on the ground. With the large number of jet positions available, and with the various types of orifices on the market, or capable of local manufacture, there is considerable flexibility in the type of spray pattern which can be delivered. The helicopter can also vary its flying speed much more precisely than a fixed-wing plane and thus the operator has a wide choice of types and amount of spray which he can put on. All this gives the pilot the opportunity to select for each job the appropriate pattern most suited to the type of weeds, or crop, the height he has to fly, wind, and humidity conditions.

Droplet size, swath width, and spray pattern can be measured only when the plane is actually flying. This necessarily means a lot of equipment and labour. A variety of techniques have been developed for this purpose. The simplest we found was to put out an array of 1 yd. long boards covered with newsprint which had been impregnated with dry dye crystals. When droplets land on such a surface, they dissolve the dye which marks the paper giving a record which can be kept and studied. This technique was used by Lynch *et al.* (1) in their studies of helicopter spray patterns compared with a fixed-wing plane.

Marker stands with sensitive paper arranged at different levels were used to measure the penetration of spray through tall weeds (*e.g.*, gorse), and also to record the impact of spray on lower surfaces. Though overseas workers claim that with helicopter spraying both upper and lower surfaces of targets get covered, we found that, with the fairly coarse type of water spray, generally most suitable here, very little spray reached the undersurface of leaves directly. This does not matter with hormone weedkilling spraying. However, on crops sprayed with insecticides when still only a foot or two high, the turbulence created by the low flying helicopter turns many of the leaves over briefly so that they can accept the falling spray before turning back to their normal position. This is very useful when dealing with grey aphis on crops such as choumoellier or turnips.

WATER VERSUS OIL

It was felt that the slow and therefore low flying capabilities of the helicopter enable water to be used as a carrier in preference to oil. Oil is expensive, requires special arrangements to deliver to the landing site, and, with hormone weedkillers, can cause excessive damage to clovers.

After 18 months' work, it still seems unnecessary to use oil.

PREPARING AND FILLING SPRAY LIQUIDS

Initially, improvised methods were used but now Helicopter Services have developed efficient filling methods which reduce the possibility of errors in mixing to a minimum and by the use of powerful pumping gear can refill the helicopter in the minimum of time. Experience in the topdressing field, where time on the ground under favourable flying conditions must be cut to the lowest possible, has proved valuable. The Hiller can land, reload, and take-off in one minute.

MARKING OF TARGETS

This is a controversial topic. It is obviously ideal where precise quantities of materials are to be applied to a complex area for some method to be available to guide the pilot in precision flying. Where the target is rectangular in shape and easily accessible, flagmen can do this. As most targets are complex and inaccessible, the pilot's skill and judgment have to be relied on. It still seems possible, however, to design a machine, especially for the slow flying helicopter, which can mark the track of the plane as it flies and provide a guide for subsequent swaths. This point has been discussed more fully in a previous paper (2).

Results of Agricultural Work in N.Z.

INSECTICIDES

Fodder Crop Pests

The first commercial operation in N.Z. with a helicopter was an emergency spraying of choumoellier crops in Karaka, Auckland, in January, 1955. Under drought conditions a wide range of insects, mainly white butterfly and grey cabbage aphis, were skeletonizing what little crop had been able to grow. Using a B.H.C. preparation "Gammexane" L 20 at a quart per acre in 4 gal. of water, the helicopter sprayed about 100 acres of crops—all typically small areas of a few acres each. The American pilot who delivered the Hiller showed how a helicopter could be used in confined areas close to shelter belts, telephone lines, etc., and deliver the spray accurately up to the fence line. Coverage was satisfactory and good kills of insects were obtained. Rapid recovery of the crops affected followed—which was not surprising in view of the enormous number of insects present before spraying.

Army Worms

No further insecticidal spraying by helicopter was carried out until the recent (April-May, 1956) spraying of pastures in the Wairoa district with a Dieldrin preparation "Dieldrex." Successful kills were obtained with 1½ pints in 4 gal. of water per acre. Work was proceeding satisfactorily until the Hiller met with the accident described earlier.

Helicopters, like other aeroplanes, are subject to a rigorous schedule of maintenance checks designed to reduce mechanical breakdown to

a minimum. But a bolt within the engine which should normally have an indefinite life broke because of some hidden flaw. This part, worth a few pence, resulted in extremely costly damage.

This accident illustrates one of the weaknesses of using a highly specialized machine on its own far from its source of manufacture. Unless large stocks of expensive spares are kept, the loss of business can be more costly than the damage to the plane itself. With the greater use of helicopters in New Zealand, more elasticity in the availability of machines, spares, and pilots will cushion breakdowns and accidents, and will enable farmers and growers to be more sure that the job they want done will be carried out at the time they want it. This is particularly important for insect control.

WEEDKILLERS

By far the greatest interest in the use of helicopters so far has been in weed control. Most of the work has been on hill country where ground machines are difficult to operate. New Zealand is in the process of a rapidly increasing interest in aerial application of agricultural chemicals. This started with superphosphate and many companies formed to develop the topdressing market are finding that aerial weedkilling is a lucrative sideline—lucrative because, for reasonable charges to the farmer, they are able to clean up weed problems which were formerly almost impossible to cope with. Figures obtained from the Civil Aviation Administration show that, in the year ended March, 1956, nearly 400,000 gal. of spray of all types were delivered from the air. This weight, approximately 2,000 tons, is small compared with the superphosphate figures but it is rapidly growing.

Thistles

Winged, variegated, nodding, and Scotch thistles, particularly the first two in certain districts, are not merely noxious weeds. They can crowd a farmer off his farm. It is only a few years ago that a farmer achieved some publicity by the ingenious use of a horse to carry spray materials and pump on its back while two men walked with the horse through the thistles carrying the spray boom. Now hundreds of acres a day can be done from the air at low cost with the farmer figuratively watching the operation from a rocking chair on his front porch.

Where thistles stretch in unbroken masses over large areas, the fixed-wing plane can often compete with the helicopter. But where, as is more often the case, the patches of infestation are separated and of irregular area, growing on ridges or in gullies, the precision spraying of the helicopter can result in a better job with more economy of spray.

The Hiller has sprayed considerable areas in Wanganui district and the Bell has recently been working in Hawke's Bay.

Willows

These trees present a formidable problem to ground crews when mechanical extraction or killing with hormones is attempted. Swamps,

mud, and other obstacles are no problem from the air. Extensive spraying of willows from the air in both Islands has been carried out. The Hiller was used on about a hundred acres in the Waikato in November-December, 1955. It is too early yet to assess results. It is likely that more has to be learnt about the optimum conditions for spraying the various species of willows before consistently good results can be assured.

Broom

From some few acres sprayed from the air at the rate and by the method used for gorse, it appears that a high proportion of kill can be obtained. A trial area was treated from the Hiller near Waiotapu in November, 1955, and appears to be very successful. Large areas of similar infestations await treatment.

Blackberry

Though aerial spraying is no more successful in destroying blackberry at first attempt than is ground spraying, yet it is very successful in killing off the current growth and imposing a serious check on the plants, which, if followed up the next year, should result in a high percentage of kill. Not much work has been done on blackberry as such but it has been present among gorse targets and has always been killed off to ground level very rapidly. Plants growing at the base of tall gorse provided useful indicators of the penetration of the spray through the gorse canopy to the ground.

Gorse

The control of gorse is a most interesting problem. The weedkiller 2,4,5-T will kill gorse but it is generally believed that at least 300 gal. of water as a diluent is needed per acre to spread evenly the 1 gal. of hormone over the complex surface of the gorse. If the coverage is not complete, the gorse plant will not be killed. Many attempts to kill gorse from the air have been made. For reasons of economy it is not possible to apply from the air more than about one tenth of the water that ground equipment is accustomed to use. People are thus not very surprised when poor kills with a lot of regrowth follow aerial spraying.

With the advent of the helicopter it seemed that things might be different. The slow flying speed, rotor downwash, and ability to fly close to the target all seemed to add up to the ability to spread the 2,4,5-T evenly over the gorse without the need for large quantities of water.

The first helicopter spraying of gorse commercially was done by the Hiller on 35 acres at Papakura on March 7, 1955, using 27 gal. of water with 1 gal. of 2,4,5-T per acre. The technique used was to fly up and back along the same swath then to repeat this process at 30 ft. intervals. As the swath width is 60 ft., this gave 4 passes, each of which delivered 7.2 gal. per acre.

This trial showed an impressive browning off with the typical original orange-brown discoloration of gorse when treated with 2,4,5-T. After 7 months there was negligible growth. At this stage,

unfortunately for the experiment, it was decided to cut down the gorse to avoid a bad fire risk.

Another patch of gorse of 10 acres in the same district, sprayed two weeks later also showed good browning off. This is still untouched but is now showing considerable regrowth. It also shows where the plane has not been accurately flown. Another treatment of this target now seems necessary. An interesting point is that a patch of manuka in the target seems to have been largely destroyed.

Late in March, 1955, a trial was arranged by the Department of Agriculture in Whatawhata to compare the effectiveness of a fixed-wing aircraft (Tiger Moth) and of the Hiller. On the day the Moth was flown with great skill and accuracy (but at what seemed considerable risk) while the Hiller pilot had an off day. An acre of similar gorse was sprayed by ground rig at the rate of 900 gal. per acre. The present position is that none of the areas show good results, indicating that the conditions at the time of spraying were poor—probably too late in the season.

Gorse sprayed from the Hiller in November, 1955, in the Waikato is at present looking very dead with very little sign of regrowth. With the spring it will be possible to judge just how effective this application was. But it looks as though spraying early in the season may be more successful than late—provided the weather conditions are good and the gorse is growing well. It is significant that, in all targets sprayed from the air under reasonable conditions, some or many gorse plants have been killed outright. This shows that only perhaps a slight improvement in technique may result in greatly increased success.

In an attempt to learn more about the problem, a trial was laid down with the Hiller in March, 1956, at Linton, near Palmerston North in which four different treatments were applied to 2 to 3 acre plots on the one day. It is too early to make any comments on the result of this trial. But an attempt has been made to find out whether increasing the cost of the treatment, either by adding more hormone or using more water, will give better results justifying the extra cost.

Future Possibilities

Manuka

The ease with which manuka can be killed by 2,4,5-T suggests that spraying from the air may be a more reliable, controlled, and certainly quicker way of removing it than waiting for manuka blight to do the job.

Dusting

For small size targets such as fodder crops, dusting may prove to be cheaper and easier than spraying. The farmer or grower would arrange to have the necessary amount of dust on the site. The weight of dust required per acre is usually a lot less than a corresponding amount of spray. Water, mixing problems, pumps, tanks, etc., are all dispensed with and the helicopter can move from job to job with-

out all the administrative arrangements which characterized the Karaka job.

FOGGING

This equipment enables very small quantities of concentrated insecticide to be applied in a very finely divided and potent form. It is available for both Hillers and Bells. Its uses are spectacularly successful in America for the control of sandflies and mosquitoes. It can also effectively deal with pests of forests where, once the fog has been driven into the sheltered atmosphere between the trees by the rotor downwash, the minute insecticidal particles can penetrate throughout dense foliage.

TOPDRESSING

Farmers in many places would like to topdress from the air odd corners which are too difficult for ground equipment but which are not large enough to justify the expense of an airstrip. Using concentrated super., the helicopter could tackle such jobs at a reasonable cost. It is also ideally suited for seeding work and for spraying solutions of trace elements.

FORESTRY

In our important exotic forests, one of the most difficult silvicultural operations is the treatment of clear felled areas to promote regeneration of the desired pine trees in competition with more vigorously growing native species. Line cutting and clearing on the ground is hampered by the ubiquitous "slash" or tops, branches and stumps of the felled trees. Experiments are planned to see whether spraying of suitable herbicides from the helicopter can check the native vegetation and release the pines.

Attempts to thin established stands of regenerating seedlings from the air will also be made.

Acknowledgments

Acknowledgments are made to I.C.I. (N.Z.) Ltd. for permission to give this paper; to R. Scott and Helicopter Services Ltd. for co-operation; and to D. C. Isaacs and H. W. Johnston of I.C.I. (N.Z.) Ltd., and the Bell Aircraft Corporation for the loan of some of the illustrations used.

References

(1) LYNCH P. B., MATTHEWS L. J. and THOMPSON F. B. (1956): Measurements of Distribution of Weedkilling Spray applied to Gorse (*Ulex europaeus*) by Helicopter and Aeroplane. *N.Z. Jour. Sci. Tech., 37* (A): 505-22.

(2) LITTLE E. C. S. (1955): The Potentialities of Helicopter Spraying. *Proc. 8th N.Z. Weed Control Conf. 1955*, p.49.

(3) RIPPER W. E. (1955): Application Methods for Crop Protection Chemicals. *Ann.App.Biol.*, Feb.

(4) POTTS S. F. and SPENCER R. A. (1953): Air Blast Spraying for Helicopters. *J.Econ.Ent., 46*: 147.

(5) BROOKS F. A. (1947): Drifting of Poisonous Dusts applied by Airplanes and Landrigs. *Agr.Eng., 28*: 233.

CROP SPRAYING AND DUSTING AND THE HORMONE TREATMENT OF WEEDS

P. S. FERENS*

Introduction

THIS SHORT REVIEW OF THE application of aircraft to weed and pest control in New Zealand will cover the types of aircraft being used, materials, the hazards of these materials, and then a short discussion on each of the main weed and insect species at present being successfully sprayed from the air.

Of the twenty-odd spray aircraft licensed in New Zealand, the majority are still Tiger Moths. However, there are growing numbers of Piper Cubs, Cessnas, Taylorcraft, Austers, etc., and, of course, the two helicopters. Most of the equipment is of the wind-driven pump and underslung boom type, but several of the I.C.D. rotary brush sprayers are in use. The rates of application of these aircraft vary between 3 and 10 gal. per acre, with the exception of one experimental aircraft, which will be discussed later, that can apply 20 gal. per acre in one run.

No paper on chemical weed control would be complete without the usual words of caution in respect of susceptible plant species. Many of our desirable horticultural plants, more particularly grapes and tomatoes, are many times more susceptible to the hormone weedkillers than are our farm weeds.

The hormone weedkiller is best described as a synthetic equivalent of a growth compound already occurring within plants and, to all intents and purposes, all that we do when we spray with these materials is to apply (usually in a liquid form) an overdose of this growth compound. This in turn accelerates the growth rate of the plant, makes the internal cells stretch and expand, changes the internal metabolism of the plant in many ways, and the plant ultimately grows itself to death in the matter of a few days. This, then, is the basis of hormone weed control, which must now be adapted to application from aircraft to those plants which can be successfully treated from the air.

It should be emphasized at this stage, that only those plants which can be very successfully treated from the ground or are very susceptible to hormone weedkillers can be economically sprayed from the air. Over one hundred thousand acres of aerial spraying was undertaken in New Zealand during the last season. Of this, about 70 per cent. of the spraying was for the control of winged and variegated thistles. Without going into detail, as a means of comparison, the rate

**Field Research Officer, Ivon Watkins Limited, New Plymouth.*

of application is 1 lb. 2,4-D acid equivalent in three or four gallons of diesel oil per acre. The reasons for and against using diesel oil as a diluent will be explained later.

Other plants treated from the air are lupin, of which many acres in the centre of the North Island have been treated. Willows all over New Zealand offer a big field, as does nassella tussock in the South Island where applications of T.C.A. 90, whilst not actually controlling the tussock, are checking its spread and preventing seeding.

Much publicity has been given to the aerial spraying of gorse but poor results have so far been obtained; the main reason is the limited amount of liquid that can be applied from the air. By fitting an Auster Autocar aircraft with an improved spraying system, this limitation has been partly overcome, but water application from the air is still a long way from practical ground application equivalents. However, by experimenting with droplet size and depth of spray shower, it has been possible to make 20 gal. of liquid per run go a long way. Gorse areas in the South Island were treated six months ago with a gallon of 2,4,5-T to the acre in 40 gal. of water per acre in two runs with the Auster aircraft. The main features of note were the total coverage achieved and brown-off and subsequent absence of any green tips or regrowths of any type. However, it is too early to draw any conclusions. It is fairly certain that a portion of regrowth will occur, but even so the initial result is the best yet obtained with an application from the air in New Zealand. It is intended, in the coming season, to do further work on this problem in the hope that some practical economic possibility of spraying gorse from the air may be obtained.

General Application Data

The quantity of liquid required to the acre varies from about 1 gal. for insecticides to three times this quantity for ideal results with hormones. If spraying is carried out under conditions of low convection, and this is highly important (*i.e.*, from first light to 8 or 9 o'clock in the morning), a fine droplet size which will fall readily in the cool air will give good coverage, and quantities as low as 1 gal./acre may be sufficient. In general, we recommend between 2 and 3 gal./acre of diesel oil in which is mixed ¾ to 1 lb. of 2,4-D acid. Our Aero Concentrate 2,4-D Non-Volatile contains 7.2 lb. of acid per gallon; one pint of this material to the total mix required per acre will give very good control, a higher quantity of material being used as the thistle growth becomes more advanced. It is generally accepted that spraying weeds in flower is not good practice as, at this stage, they become very difficult to kill.

With oil-based materials such as 2,4-D Aero Concentrate, the effect of rain is usually to accelerate the kill. This does not mean spraying should be carried out in rain, as it would quite possibly wash off the plant before it is absorbed, but rain an hour or two after

spraying or misty conditions before or after spraying will certainly make the effects more severe.

Autumn, winter, and spring treatments are carried out, all seasons being generally successful, though variable results are obtained with late spring spraying. We would recommend most strongly that aerial spraying of thistles be undertaken between the period May/August and later than this period only in a favourable season. Apart from the fact that results vary after this period, the plants are so advanced that they require a much higher rate of application to bring about their control and this, in turn, tends to make the job uneconomical.

There is relatively little thistle spraying from the air in the South Island. Costs per acre for application of 1 lb. of 2,4-D Aero Concentrate in 3 gal. diesel oil per acre, inclusive of flying costs, are roughly 28s. per acre.

On the east coast of the North Island, numerous other plants have been aerial sprayed, some specifically and others in conjunction with the ordinary thistle programme. One of the most notable perhaps is burr clover (*Medicago hispida*), a most undesirable plant which can be most successfully sprayed from the air with 2,4-D Aero Concentrate at a very economical rate.

LUPIN (*Lupinus arboreus*)

Large areas of lupin have been sprayed from the air in the sandhills south of Wanganui by one operator using 1 lb. total mixed 2,4-D and 2,4,5-T esters in 10 gal. of water. A very high measure of control seems possible. The past season's work over some 2,000 acres has shown that application is the greatest problem in control. Best control achieved has been obtained after flying "*between*" the bushes rather than over and we can expect the aerial operator to be forced into using heavier applications of water in order to reduce the flying risk and yet obtain coverage.

BROOM (*Cytisus* spp.)

At present we have no positive information on broom control but have under observation three areas which have been treated from the air with mixed esters of 2,4-D and 2,4,5-T and water. The time of application, of course, must be that to suit the plant and the preferred time is during full flower or early pod formation. Applications have varied between ½ and 1½ gal. mixed ester per acre in 15 gal. of water. Initial results are encouraging but, as yet, no final recommendations can be made.

RAGWORT (*Senecio jacobaea*)

Much of the ragwort-infested country is on land inaccessible to ground spraying equipment. Apart from this inaccessibility, it is a constant source of spread to adjacent areas. If this plant could be successfully controlled from the air, it would make eradication of this most undesirable weed much easier.

Two areas have been treated from the air, one in Hawke's Bay and one in the National Park area, using both oil and water as diluents

and Aero Concentrate 2,4-D from 1 to 3 pints per acre. These areas have been done only a relatively short period and results are in no way complete, but interim reports are most promising.

A number of other plants have been sprayed from the air but those mentioned are of major importance. Others which are important in isolated areas are nassella tussock (*Nassella trichotoma*), which is treated from the air with T.C.A. 90, and cereal crops treated with amine 2,4-D in water. In several areas, the spraying of willows from the air is being considered and, in at least two cases, it has been decided to go ahead and see what happens.

Refilling, Mixing, and Agitation

For successful operation of an aircraft spraying rig, quick refilling of the aircraft is the most important feature. Our suggestion is the use of a 1½ in. self-priming centrifugal pump (engine-driven) with an output hose and a bowser-type petrol nozzle on the end of the output hose for on/off control at the aircraft. The other end of the pump could be coupled to 1½ in. piping of sufficient length to go to the bottom of the average 44 gal. drum; mixing can be done in the drums by adding between 1 and 2 gal. of Aero Concentrate to the 44 gal. and stirring as required. It should then take approximately 1½ minutes to refill an aircraft.

In mixing the spray, good stirring is essential. Stirring should be repeated prior to refilling and, if the aircraft is left standing, prior to take-off.

Effect on Stock

The question of whether stock should be removed from the area to be sprayed is not critical. Most operators like to see stock left on the thistle as it wilts badly and is readily eaten by the cattle. In some districts, where variegated thistle is extremely thick, cattle can be harmed by toxicants in the thistle if it is over-eaten.

Atmospheric Conditions and Drift

The avoidance of even light winds is essential for both good control and freedom from damage claims from neighbouring properties. Damage has been reported at 15 miles following spraying under unfavourable conditions in some districts. The wind was 12 to 15 m.p.h. and spraying was done during the warmer part of the day when the convection rate was high. The theoretical minimum convection rate is 100 ft./min. for the ideal droplet size and this figure is reached early in the day under most conditions. Small smoke candles can be used to estimate the convection rate. If the convection rate is high, patchy work and poor control will result, almost regardless of the droplet size.

To reduce the possibility of damage to neighbouring properties, Aero Concentrate is normally supplied in *Low-volatile* form.

If spraying is done "cross-wind," flag-markers are usually necessary for each run. Because of variations in wind strength, coupled with variations in height flown (even small variations) the swath laid down will not consistently fall the same distance down-wind on each run. Good men are needed as judgment is necessary.

Insecticide Application from the Air

Whereas weedkiller application can be undertaken over a period of months in respect of any weed pest, the application of an insecticide is usually an emergency job. A particular insect is noted and if not checked can literally eat out a crop overnight.

The application of insecticides from aircraft calls for better flying and if anything better conditions for the spray application. As one expert on crop spraying once put it: "If the wheels of the aircraft are in the crop the pilot is too high, and if the cowling of the aircraft is in the crop the pilot is too low."

Most of the crops sprayed from the air for the control of white butterfly, aphis, diamond-backed moth, green vegetable bug, army worm, cut worm, etc., are standing crops and usually cannot be sprayed with ground wheel equipment. Here, provided the area is topographically suitable, the aircraft comes into its own, both for speed of application, which minimizes further damage from the insecticides, and effectiveness of the spray application. This present effectiveness with spray applications, however, does not come about automatically. In the last four years, dust applications of D.D.T. and lindane mixed with fertilizers and other fillers have been tried with fair success, while baits of bran, engine oil, and insecticide have been used from topdressing hoppers for cut worm, etc. Because of the growing importance of insecticide application, the ordinary top-dressing hopper is unsuitable and about 90 per cent. of insecticide applications are now from aircraft fitted with spray apparatus using either emulsion concentrates of D.D.T. or lindane (or other insecticides), or in some cases wettable powders.

The application of the liquid amount of insecticide in 3 to 6 gal. of water per acre has given ideal results. However, when the crop is nearing the mature stage, and this applies particularly to choumoellier, turnip crops, or any crops with a large amount of leaf area, the water content should be increased to about 10 gal./acre. A word of caution should be sounded here because lindane, D.D.T., and other insecticides can be most toxic to bees, and, to obviate unnecessary bee losses, these applications should not be made when crops are in flower or are being worked by bees.

To summarize, spraying of insecticides and weedkillers in our agriculture from the air is quite a new field, but it is advancing and extending very rapidly. The extent of its development depends on seasonal conditions. Conditions which predispose crops to insect infestations vary from season to season and weed growth varies to the same extent, so that the application of insecticides from aircraft or

from the ground must also vary from season to season. However, once farmers have the knowledge that aircraft can do a job both efficiently and effectively and that their use is economic, a very large expansion of their use can be foreseen.

Acknowledgment

Thanks are due to Messrs. Ivon Watkins Ltd. for allowing me to present this paper, and to my associates for much of the information contained in it.

DISCUSSION

Q:: *Have you had any difficulty in handling barbed wire from the air?*

MR SIMPSON:: We have not had any great difficulty with it at all. We thread No. 8 fencing wire through four reels of barbed wire and attach it to the ends of a larch post which is then slung underneath the wing in the same position as a bundle of posts would be. With this method no trouble at all in dropping them has been experienced.

Q:: *Would Mr. Ferens tell us whether he has had any experience of spraying Californian thistle, and what results were obtained?*

MR. FERENS:: Presumably you mean from the air. From the ground Californian thistle is one of the most difficult weeds to control. We have therefore not put any effort into attempting control from the air, but on many occasions it has been one of a mixed population of weeds that has been sprayed. All that has been noticed is a very rapid top kill with almost more rapid regrowth. No control of Californian thistle has been gained from the air in my experience, that is, at economic practical rates. If a real attempt is made to control such weeds it can be done, but at a price.

Q:: *With regard to the spraying of broom in the Rotorua area. Could you give us some more details of the spray used and the method of application?*

MR. LITTLE:: The broom was sprayed in the same way as for helicopter gorse spraying—that is, one gallon of 2,4,5-T per acre in about 30 gal. of water, sprayed over the target in four passes. This broom looks particularly hard hit but we shall have to wait for the spring to assess the results.

Q:: *What time of the year should broom be sprayed?*

MR. LITTLE:: The best time of the year to spray is not known for a fact, but it is generally agreed to be early summer or possibly late summer and autumn before it gets too cold. I should say, therefore, that November-December or January-February, avoiding drought periods, would be the best times.

Q:: *Could Mr. Simpson tell us whether he has any experience with movable roof bulk-storage topdressing buildings for the farm?*

MR. SIMPSON:: Yes. There are one or two on the market now. Cable-Price Corporation are marketing a type of bin which is very suitable. It

comes in 10 ft. sections 20 ft. wide, with a gable height of 7 ft. 6 in., so that it can be built to any desired length. This is suitable for the bin type of storage where the shed actually overlaps the bin on to rails and can be moved off and on the bin for loading and unloading purposes. Where banks are available on a strip we have sometimes advised that the bin should be built in the form of a concrete parapet alongside the bank; the roof is then supported on the rails on top of the parapet, allowing for tipping off the bank and working out of the bin on the strip level below. There are many forms of this type of structure which can be utilized in a number of ways. There have been one or two other types made up by local engineers, which have been very successful.

Q:: *Would Mr. Ferens comment on the aerial control of grass grub using either dust or spray?*

MR. FERENS:: My experience is very limited in the field. We did some work with J. M. Kelsey of the D.S.I.R. Entomological Research Station at Ashburton last year, comparing dust applications and spray applications of D.D.T. from the air at recommended rates. While one can apply the given amount of D.D.T. with superphosphate or any other filler, as is done from the ground, there appears to be no great advantage, on the type of country being treated, from doing it from the air. The question of more effective spray applications also enters the argument. The quicker the material penetrates the ground, the quicker the toxic material becomes available to the grass grub, and spraying is a means of doing this. Applied from the air in a very limited amount of water, the spray does not even amount to a very light dew, and to get the material into the ground requires half an inch of rain which cannot be reproduced from the air. Therefore, there is definitely no advantage there. Where it is considered to be warranted or necessary, a dust application from the air is comparable with that from a Monro type of topdresser or something similar. Spraying for grass grub has not yet been proven effective.

Q:: *There does not seem to be any effort being made to overcome the problem of sowing slag from the air.*

MR. SIMPSON:: This is a big problem, especially in its present form. We have tried to sow it for many years. We find, in the main, that in its present form it handles with filler—either super. or lime—and the proportion is variable according to the degree of maturity of the filler. If it is particularly mature super. in a good, clean condition, we have handled it with up to 50 per cent. basic slag. If it is inclined to be a little bit green, it cuts down the proportion of slag that can be carried, the average being about 30 per cent. The problem with slag is not entirely one of getting it out of the aircraft. Our problem is to sow it 100 per cent. out of the aircraft, and we just cannot do that without an agitator in the hopper. Even if we can get it out of the aircraft, the next problem is to get it on the ground. That is where we have considered, in the past, that it is not an economical project from the air. It has to be handled in absolutely ideal conditions—still wind conditions—and then a fair proportion of it might reach the ground. It will float for miles. Even where it has been put in proportionately with super., it separates from the super. in the air, and one can see the super. go down on to the ground while a grey shadow of the slag hangs in the sky—and it can be seen for some time afterwards. However, we have some better news. We have just done some trials with oiled slag. There were some trials at Pahiatua recently,

I have heard varied reports about them—they were not done by my own company—but I heard today that we have just carried out some trials in New Plymouth, and at the moment the report I have is very good indeed. It has been sown 100 per cent. in a 10 to 15 m.p.h. cross-wind. The drift factor amounted to 4½ chains. When we know a little more about that, and feel that it is something that we can handle and do a job with, we will be making it known.

Q:: *Are dieldrin and aldrin used as insecticides in New Zealand?*

MR. LITTLE:: Dieldrin has been used for the control of army worm in Wairoa district. The work was carried out recently by the Hiller helicopter. Aldrin is, of course, being used in New Zealand for sheep dipping, but has not, as far as I know, been used yet for treatment of crops, though it is very successfully used in Britain for the control of wireworm in potatoes.

Q:: *What is the value of Dalapon for the control of barley grass?*

MR. FERENS:: Prior to this year we have been posed with quite a problem in the control of barley grass, which is a shallow rooting annual and one of our undesirable weed grasses. It has been controlled with trichloracetate —T.C.A.90—sodium chlorate, and other weed-killing chemicals, but they have not been successful. They have not been completely selective. Some have killed just the seedling grasses, taking out desirable seedlings as well as undesirable ones, and leaving the mature grasses. Dalapon is the first distinctly selective grass killer at given rates. For instance, at 2 to 3 lb. per acre in a low volume of water, it will selectively take out *Poa annua,* goose grass, and barley grass. At the higher rates it takes out a different range of grasses, such as timothy, and damages others. At those given rates, at the correct time of the year, which is at the seedling stage when the barley grass is no more than 2 or 3 in. high—either the spring or the autumn germination, whichever is preferable in the district—it has proved most successful. It has one or two shortcomings in that at least 48 hours' dry weather are required following application, because it is a wettable, powder-type formulation, and deposits a little crystal on the leaf blade of the grass, which can be washed off with a heavy rain shower. In the ground it does not do its job, because it is absorbed into the leaf blade of the grass in the same way that 2,4-D is with the broad-leaved weeds. Since we are dealing with aerial application, I should mention that the application rate is so low in total quantity of liquid that it can feasibly be applied from the air. In fact, we have some trials planned for August-September in the Waikato and Wanganui areas applying Dalapon on hill country for the control of barley grass. So it appears that we are making a forward step in that field. Dalapon is on the commercial market, and I think most companies have it.

Q::*Have you had any experience of treating docks in lucerne with hormones?*

MR. FERENS:: Docks have posed a problem with hormone weedkillers. In pasture they are in part dealt with by various hormone weedkillers, but in lucerne stands and clover crops the use of hormone-type weedkillers is precluded because of the damage to the associated crop. However, there is another growth regulator, malaic hydrazide, which is available for suppressing growth of grass, reducing suckering in tobacco, and a number

of similar things, and it does show distinct herbicidal tendencies on some weeds. It has controlled seedling broadleaved docks and killed docks at given rates, and at those rates, although it is not particularly harmful to lucerne, it will burn the basal leaves off lucerne and stop growth for about three weeks. At the correct stage of the year, docks can be controlled in their first year of growth with malaic hydrazide, without any great damage to lucerne. The new "Butyrics" 2,4-DB and M.C.P.B. may also prove of value in lucerne stands or legumes generally.

Q:: *Has aerial spraying of ragwort been completely effective? And what time of the year is it best to spray it?*

MR. FERENS:: Ragwort is another of those plants which could be placed in the same category as Californian thistles. It is a difficult perennial weed which is hard to control from the ground. The stage of application is critical; the rate and conditions of application are also critical. We have done seven or eight areas experimentally from the air. In seven areas it was a complete failure, while in the eighth it was an outstanding success. There was no rhyme or reason about the results at all. We are not recommending application for ragwort from the air. Many farmers have tried it and been disappointed. I suggest that, until improved formulations of hormone weedkillers or improved techniques of application are developed, the expense of spraying from the air is not warranted. If you want to be very drastic, you can go to the other extreme, although it has not been tried successfully, and use 2,4,5-T from the air with diesel oil. Whilst it does a good job on the ragwort, it is also most damaging to the associated pasture species.

Mr. Little's company has done some work on ragwort control and perhaps he would care to add to these comments.

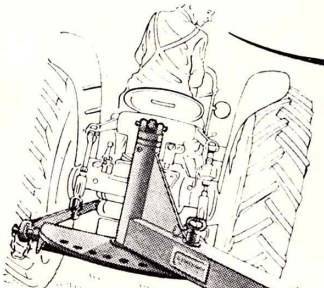
MR. LITTLE:: Some cynics or wise men say that the best chemical application from the air to control ragwort is superphosphate, because, if you manage your farm properly and cultivate desirable pasture species by improved methods, you can in that way eliminate the weed. I disagree with Mr. Ferens in his reaction to the general question of the application of weedkillers from the air. I feel that if you can get a good result from ground treatment, then you should also be able to put on the same applications and get the same results from the air. It is only a matter of skill and technical abiiity. Where results on plants like ragwort have proved a failure I would like to suggest that perhaps it is not so much the fact that it is put on from the air as that it is not put on properly, or not at the right time.

Q:: *What are the best conditions for ragwort control?*

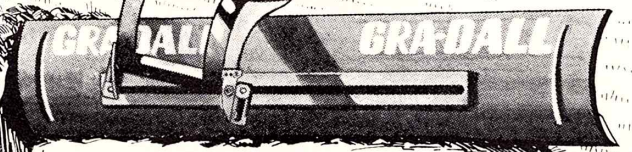
MR. LITTLE:: It is most easily killed when in the rosette stage. However, as ragwort plants are both in the rosette and also in the flowering stage at any time of the year, it is difficult to treat all the plants in any one paddock all at the rosette stage. The time for treatment is either in the spring or in the autumn, when most are in the rosette stage.

Q:: *I should like to ask Mr. Simpson how his company is progressing with dropping baled hay from the air.*

MR. SIMPSON:: So far we have not dropped baled hay from the air, but will be doing so in the near future when the equipment for the trials is ready.



"You can't farm successfully without a GOLD MEDAL GRA-DALL !"



GRA-DALL WON THE GOLD MEDAL AS THE OUTSTANDING IMPLEMENT AT THE ROYAL SHOW, CHRISTCHURCH, 1955.

FEATURES: Heavy construction increases cutting ability - 9 main frame angle adjustments - 3 blade bevel adjustments.

MOULDBOARD: 28 angle adjustments - shift 22" - tilt 22" - length 6 ft. - height 16" - replaceable blade - reversible mouldboard - attachments include: Land Leveller, Ditch Cleaner, Depth Control Wheel.

For Efficient Farming you must have a

GRA-DALL

the most versatile blade on the market

See it at your nearest Ford Dealer or write to:

L. BATENBURG & CO. LTD., P.O. BOX 273, LOWER HUTT

Manufacturers of Trac-tow-chain - Zephyr-Tow - Unilift - Farm Implements and Accessories

G.14.3

FARMING COSTS *Definitely Cut -*

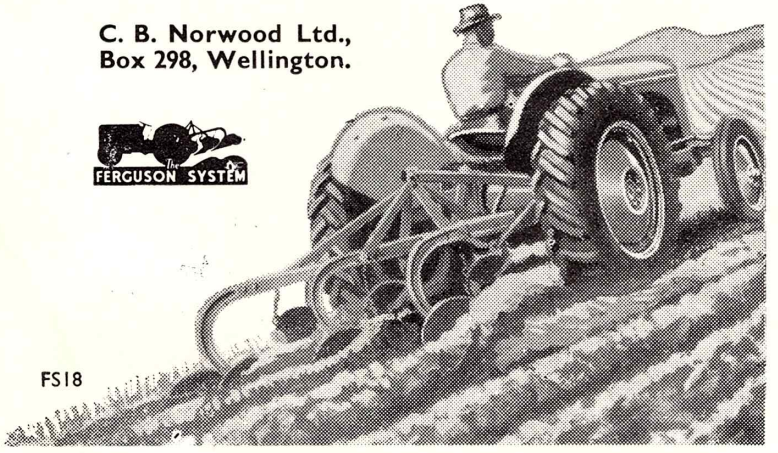
The Ferguson System of complete farm mechanisation helps you to keep costs at a minimum by farming faster, more efficiently and with less effort.

The light, powerful Ferguson Tractor is integrated with a wide range of Ferguson Implements by a system which produces traction and stability without excess built-in weight. Economical to run, simple to handle and maintain, Ferguson tractors and implements are equally useful and economical for ploughing, cultivating, terracing, fencing, draining, hauling and a thousand and one other farming jobs. Implements can be operated by one man — or a boy — from the driver's seat. The versatility of the Ferguson System enables farmers everywhere to increase fertility and raise production on every available acre.

Farm Faster, and Save Money, with FERGUSON

Ferguson

C. B. Norwood Ltd.,
Box 298, Wellington.



DEALERS EVERYWHERE

FARM DRAINAGE

SOME IMPORTANT DEVELOPMENTS TOGETHER WITH RECOMMENDATIONS FOR THE MORE EFFICIENT MANAGEMENT OF DRAINED LAND

D. G. BOWLER*

IN THE PAST FIVE YEARS several papers have been read at Massey College Sheepfarmers' Meetings describing farm drainage operations appropriate to various conditions, including the wet lowland farms, rolling clay country, and hill country flats for airfields and other uses.

The need for an awareness of what is involved has not diminished in importance. It is probably not generally appreciated that more than 70 per cent. of the land mass of New Zealand lies higher than 650 ft. above sea level and that three-quarters of the population live in the lower 30 per cent.

To consider the North Island alone, the domicile of two-thirds of the population, it is probably true to say that, with the exception of the pumice lands of the Central Plateau, no single factor influences the farming of the land more than water movement, either through its erosive effects on the hills or through poor drainage on the easy to flat country.

Where a rapidly expanding population is looking for room to live and feed itself, the problem of wet land will become progressively more important. The situation is clearly revealed in the demand for the facilities offered by the Massey College Drainage Extension Service. These requests range from hill country stations through all types of farm lands to the new playing fields in the rapidly developing urban communities.

Considering all that has been said and written on the subject, most of those farmers who must deal with the problem of wet land should, by now, appreciate the need for having the cause of wetness properly identified, be convinced of the importance of proper planning, and be thoroughly aware of the desirability of having a plan, as a permanent record of where their tiles are buried.

Those concerned should also recognize that, while ditching machines are now available in wide variety, wet land is essentially a problem related to climate, soil type, and topography. Therefore, the availability or possession of a trenching machine is, in itself, no solution to the problem, but merely the means of carrying out properly planned projects.

**Field Drainage Advisory Officer, Massey Agricultural College, Palmerston North.*

Management

Poor drainage arises from a combination of certain natural factors and, while its solution undoubtedly lies in the recognition of the cause of wetness, proper planning and the controlled use of machinery, the maintenance and exploitation of the improved soil/water relationship is essentially a matter of regular maintenance and good farm management.

In recognition of this position, the College Drainage Extension Service issues reports to farmers, at the conclusion of machine operations, offering suggestions which will lead to a more efficient use of the areas concerned.

The following points will emphasize the importance of a proper management programme for drained areas:

(1) Outlets, inlet filters, and other structures should be kept clear and unobstructed at all times and not merely serviced when the system fails to work.

Regular inspection in autumn and at least once during the winter is most desirable as the minimum job of maintenance.

(2) In general, the soil itself regulates the speed with which water will reach a drainage installation, and on winter-wet soils subjected to heavy rainfall, water will not be released as quickly as it falls.

The difference between drained and undrained paddocks is briefly this: If a half inch of rain falls during a 24 hour period on a winter-wet soil, the drained paddock, normally, will be firm and ready for use 24 hours or less after rain has stopped, whereas the undrained paddock will remain wet for many days, weeks, and often months, according to season.

It should be remembered that denudation of plant cover and pugging of the surface will tend to seal the top soil against the maximum infiltration of water. Therefore, on drained pastures, maintain a dense, vigorous sward; a concentration of stock, particularly cattle, should be avoided during and shortly after heavy rainfall.

(3) Where a tile line is loaded with permanent water as, for example, from springs, from artesian overflow, or effluent from sheds, choumoellier should not be sown directly over the tile or root blockage is very likely to follow. The remedy lies in sowing one or two drill widths over the tile line concerned in a crop such as swedes, which will not send a mass of fibrous roots into the tile.

(4) On almost all drained soils, cultivation for new grass should result in as smooth a finish as possible. On the flatter clay lands particularly, cultivation should follow the direction of moling where this has been established by a drainage survey.

Leaving deep finishes and high feerings is to be avoided especially, as this localizes wetness, limits the direction of moling, and in most cases renders under-drainage operations unnecessarily expensive.

(5) In certain localities, increasing attention is being given to the possibility of irrigation. But poor drainage can be an associated

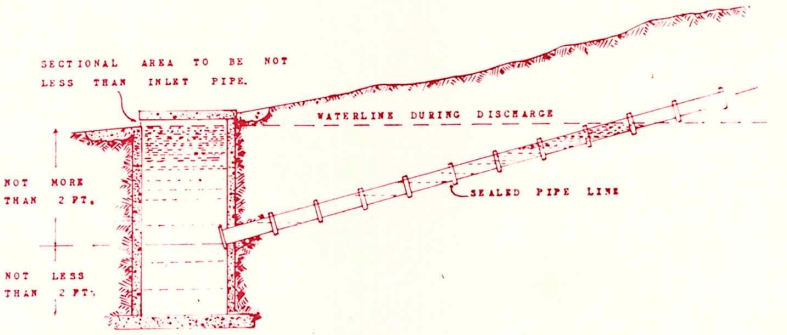


Fig. 1: Diagram of drum outlet.

problem of irrigated lands, particularly with flood irrigation. Accordingly, those interested should have competent advice on drainage before any final steps are taken with expensive earth works.

(6) Once a tile drainage installation has been completed, a plan should be prepared, and in the field each line should be marked where it ends on a fence line with a heavy peg or by painting the nearest batten a distinctive colour. Attention to this small detail will not be regretted.

Innovation

The purpose of the College Drainage Extension Service is not, as some may believe, to carry out farm drainage works on contract. It is an organization designed to co-operate with farmers in the solution of their drainage problems. Over a period of nearly ten years, an interesting co-operative arrangement has developed between quite large numbers of progressive farmers and the Drainage Extension Service. On the one hand, the farming community has the advantage of having both modern machinery and the latest methods available for their farm drainage works and, on the other,

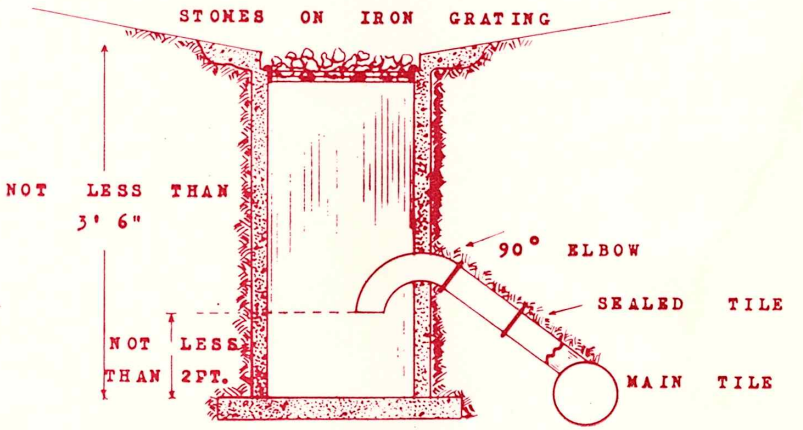


Fig. 2: Diagram of direct inlet filter with stone screen.

the Extension Service is provided with the singular opportunity of encountering a great variety of practical problems in the field and developing techniques for their solution.

A comprehensive list of the advances in techniques would occupy much more space than is available here, but some recent developments will be of interest and illustrate the point.

Tile Line Identification

The Drainage Extension Service machines cut trenches for the installation of some 300,000 ft. of tiles per year and it is obvious that this figure represents but a small proportion of the total numbers used in farm drainage throughout New Zealand. We have been impressed by the almost complete lack of dependable farm records of where such costly materials have been placed.

To meet this need, the Service issues scale plans of its farm schemes to the farmers concerned.

There are occasions on which it is necessary to find tile lines for various purposes, such as additions and remoling. Despite the use of scale plans and using a soil spear for locating tile lines, this is a difficult and time-consuming job, especially where tiles are deeply placed. To overcome this problem, a plastic-coated copper wire is now laid along the tile lines, and when the lines are backfilled we are able to connect this wire to a suitable "tone source," which sets up a magnetic field throughout the system. An audio-detector is used to pick up the signal produced. Trials to date show that tile lines can be detected up to about 25 ft. away and the wire located accurately over the tile. Not only will this method be of use to farmers but it will be of considerable value to the Service in carrying out various technical investigations.

Steps are now being taken to introduce this development into all suitable systems installed by the College as part of its routine service.

Plastic Lining for Tiles on Steep Grades

One of the most expensive arrangements in field drainage is to ensure that water being conducted down steep slopes in field tiles is contained in the tile line and not left free to escape through the joints and erode the trench. The usual approach has been either to cement the tile joints and junctions or to use bell-ended glazed pipes. Polythene lay-flat tubing is now available in suitable sizes and in various lengths from 100 to 500 ft. If this is carefully threaded through no more than 100 ft. of tile line at one time and finally secured around the inside of the tile at the top of the steep grade, our trials extending over 3 years have shown that water is contained in this tube successfully and it appears to be an economical and lasting answer to the problem. H. G. Hopewell, formerly lecturer in Soil Science at Massey College, was responsible for this suggestion.

Drum Outlets

Quite commonly a situation arises where outlet problems develop owing to boundary fences occurring in positions short of defined natural outfalls, and where gradient conditions in the area to be

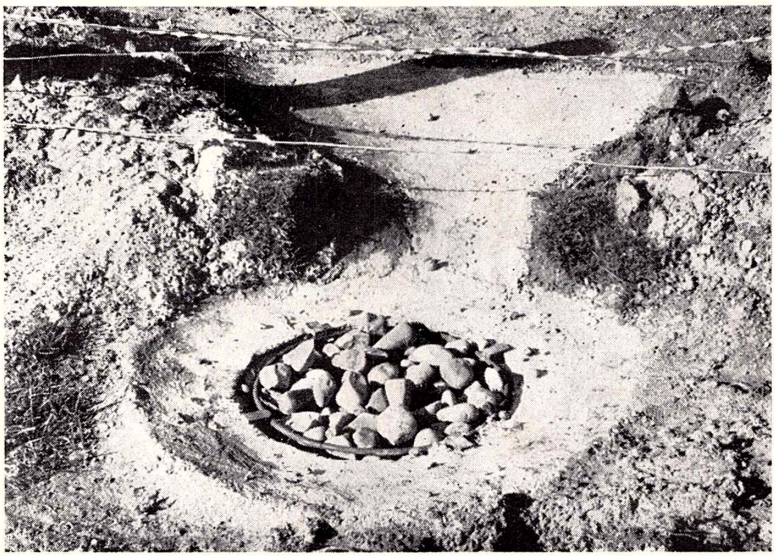


Fig 3: Installed stone inlet filter.

drained are not a limiting factor. Shallow watercourses, cut off abruptly by roads and boundary fences, offer the best example.

The usual solution to this problem lies in providing an open drain infield above the boundary to a point in the watercourse where sufficient cover is available to protect a field tile. Alternatively, it is necessary to negotiate with a neighbour for a tile outlet in his property. Neither of these methods is entirely satisfactory.

After careful investigation it has been found that some farmers, when confronted with this problem, terminated tile lines rather abruptly, either in very poor outlets, or in two cases, actually underground. Inspection of certain of these tile lines revealed that, while the immediate outlet was in poor condition, the tile line itself was entirely serviceable, in one case 20 years after installation.

An analysis of the situation showed that the hydraulic head in the tile system itself had forced the water through the poor outlets.

The College Extension Service now employs this principle in outlets of this sort by sealing the line between the outlet and a point of equal level in the tile line itself. A concreted pit, with space for silt collection below the pipe outlet, is provided at the point of discharge. (See Fig. 1.)

The use of this structure is usually indicated under the following conditions:

(1) That alternative outlets beyond the boundary are unsatisfactory or too expensive to develop.

(2) That the sealed line does not exceed 100 ft.

INLET FILTERS

Where surface water from watercourses, grassed runways, water tables at road sides, diversion terraces, etc., must be connected to underground tile lines, the most suitable structure to use is one of two types of inlet filter situated at the head and sometimes along the line.

The filter to choose depends upon circumstances. In general, these are as follows:

Stone inlet filter may be used where:

(1) The catchment topography is flat to gently undulating.
(2) The above catchment is no more than about 5 acres.
(3) Fine-textured, slow-draining soils must be drained by planned surface drainage, in conjunction with tile systems.

Direct inlet filters may be used where:

(1) The catchment topography is steep or rolling.
(2) In conjunction with tile lines installed under grassed runways.

Stone inlet filters can be dug as a pit with the stones graded from about 1 in. diameter at the surface to about 3 in. diameter immediately over the tile.

Direct inlet filters are conveniently made by using an old tar drum as boxing, digging a hole about 4 to 6 in. greater in diameter and pouring concrete in between. A steel grill cover of shallow basket design should be made of $\frac{3}{8}$ in. round mild steel and, if debris is likely to be brought in, a few stones should be placed over the screen to intercept it. (See Figs. 2 and 3.)

Tile Load Limits and Grassed Runways

Under certain conditions, and for short intervals, much larger volumes of water must be handled by a drainage scheme than the tiles are capable of carrying, particularly since farm finance generally limits the planner to 6 in. tiles.

These high flows may be dealt with in the following manner. A point is selected along the main lines of tiles at which the tiles reach their calculated capacity. (This varies widely with gradient.) Consistent with a favourable topography, a broad, shallow, grassed runway, running down the gradient and over the top of the tile, is commenced at this point, where an overflow pipe, similar in diameter to the main tile, is brought vertically to the surface. This pipe acts as a relief valve. Similar overflow pipes are provided at calculated intervals along the main and, at the surface, they are protected with a steel grill.

Under unusually heavy rainfall and drain outflows, water in excess of the capacity of the tile will rise through the overflow pipes and join the surface run-off, even though the runway already contains running water.

The tile installation, the return and consolidation of the backfill, the formation and grassing of the runway, must all be thoroughly carried out and carefully timed in relation to season.

In conclusion, it must be stressed that the various structures and devices described in this paper should be applied only where the drainage survey data have been obtained by somebody especially trained in this work, otherwise there could be a real risk of disappointment.

DISCUSSION

Q:: *Mr. Bowler mentioned the effect of choumoellier roots on tiles carrying permanent or semi-permanent water. What about the effect on moles?*

A:: Under normal conditions there is little evidence of permanent damage to mole channels through the root penetration of choumoellier roots.

Q:: *Could you give us some indication of cost, say, on very heavy clay soil with ironstone rubble on ridges near the surface?*

A:: There is no such thing as an average cost per acre for drainage on any given soil or topography. The College Extension Service provides farmers with an estimate of cost, based on a careful survey of the individual area concerned. This appears to be the only approach possible.

Q:: *What size of tile would you recommend for a normal flow of water coming from a sandstone ridge, fairly close to the surface? There is a possibility of fine sand entering the pipes.*

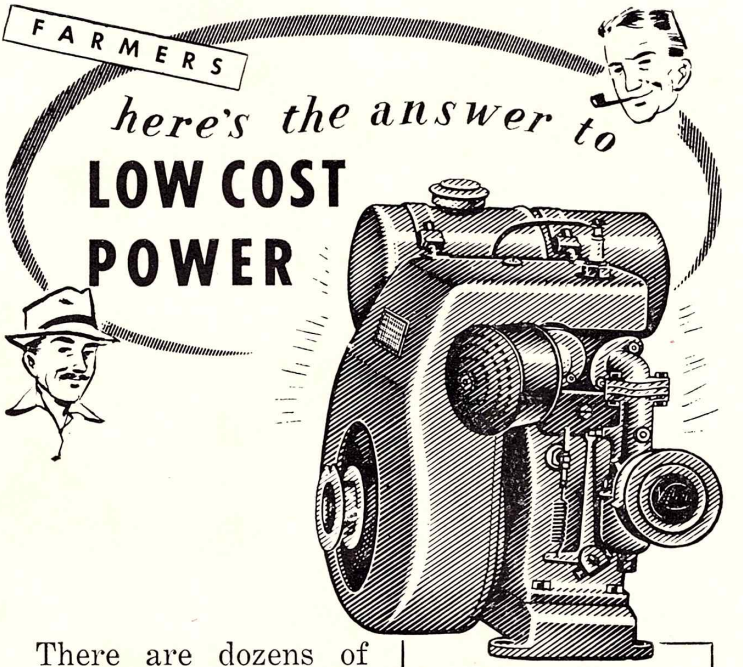
A:: There is a chart, published in the College *Bulletin No. 18* "The Drainage of Farm Lands", for computing the size of tile when slope and discharge are known. Where sand is likely to enter tiles, in extreme cases it is usual to wrap the tile in building paper and pack selected turves around the length of tile affected.

He deserves the best . . . . he deserves
TUX
The "Dog Tucker"
BISCUITS
Concentrated Wheat-meal, Meat-meal, Bone-meal, Milk, Oils, Fats, Minerals, Molasses. A balanced, palatable, completely vitamised, hydatid-free dog food.
Practical farm packs of 25 lb. and 50 lb. bags. 100 lb. sacks.
Ask your Stock and Station Agent, store,
or direct from . . . ELASTRATOR CO., LTD.
Box 226 - BLENHEIM

FARMERS

here's the answer to

LOW COST POWER



1 h.p., 2 h.p., 2½ h.p. and 4 h.p. models. Also available in same sizes with 3 to 1 and 6 to 1 reduction gear.

There are dozens of jobs on the farm that a VILLIERS can do **better** and more economically than any other engine. Sturdy construction means greater efficiency, outstanding dependability and low maintenance.

See your dealer today for full details of the engine with the world-wide reputation.

Villiers

AIR COOLED 4-STROKE ENGINES

Factory Representatives: F. W. CAVE LTD., P.O. Box 1685, Auckland

All round the clock
EUROPA
GALLONS
DAY IN AND DAY OUT
YOU'LL GET FULL-POWERED DRIVE FROM
clean burning
EUROPA
LEAVES NO ADDITIVE DEPOSITS . . . SAVES BURNED EXHAUST VALVES
Product of the New Zealand oil company

*Nexa

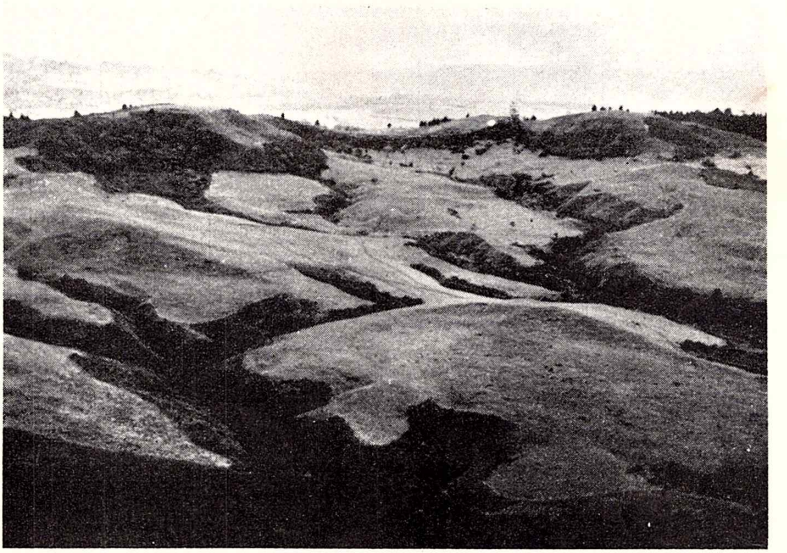
Liquid Dip

shields sheep longer!

One active ingredient, the Gamma Oil, holds insecticide and bacteriacide ratio constant throughout dipping. It is impossible for this newcomer in the field of liquid dips to strip unevenly. Highly concentrated, you mix only one gallon of Nexa Dip for every 1,000 gallons of water in bath or shower dips.

*Registered Trade Mark.

PRODUCT OF IVON WATKINS LTD.



Rolling hill country converted from fern and scrub into pasture. Gullies and steeper areas are still clothed in the original waste of fern and scrub.

THE DEVELOPMENT OF SCRUB-COVERED HILL COUNTRY IN THE PATOKA DISTRICT, HAWKE'S BAY

W. H. HARTREE, JNR.*

THE PATOKA DISTRICT IN HAWKE'S BAY is some 25 to 35 miles inland from Napier. The topography is from gently rolling to steep hills, and varies from 1,000 to 2,500 ft. above sea level. The soils are largely formed from pumice showers, and consist of rhyolitic pumice ejected from the Taupo area. There is a relatively small area of steep gully sides and hillsides from which practically all the pumice has been removed, leaving exposed soils derived from limestones, soft sandstones and other local rocks. Apart from these latter soils, natural fertility is low.

Rainfall is from 55 to 75 in., increasing with altitude and proximity to the main range. Summer rainfall is reasonably reliable, so that drought periods are comparatively rare when compared with much of Hawke's Bay. Snowfalls become more frequent on the higher land, and usually three or four falls of about 2 to 4 in. are experienced every winter. Snow at lambing time does cause losses. Temperatures

**Farmer, "Manaroa", Patoka, R.D., Napier.*

fall rapidly with increasing altitude, and the cold of winter and early spring has a strong limiting influence on the rate of grass growth. Water supplies are variable; fortunately we are in a well-watered area.

Description of Farm and Brief History

This farm of 2,621 acres, mostly freehold, was purchased on March 1, 1945. Approximately 1,300 acres are capable of being ploughed or giant disced, the remainder being made up of steep hills and gullies. The land is high and much of it is exposed; apart from the bottom of a deep gully, the lowest land is 1,600 ft. above sea level, the average height being about 2,000 ft. and some of the farm being as high as 2,400 ft.

When white settlers arrived about 1860, the farm was covered in large areas of fern, tutu, flax, some light bush in the gullies, odd patches of manuka, and some small areas of tussock and danthonia grassland. After the initial burning of the fern land and the sowing of grass, there was sufficient fertility for some large areas of grazing land to be developed. There had been brief periods of relative prosperity during boom times, but for most of the time the land was quite marginal.

The use of the plough was rather a risky business, especially if ploughed more than once. On land used for the growing of oats in the 1930's, serious wind erosion set in. Four paddocks totalling 161 acres were badly eroded in many places, some considerable areas being blown clear of soil to a depth of 3 ft. Altogether, some 367 acres of the flatter areas were cropped and grassed, but with falling fertility, and in latter times rabbits, these areas became largely browntop dominant. Manuka invaded these paddocks, especially where they had been blown.

The farm had been fenced into 28 paddocks and much of the bracken fern was crushed out, but, as the fern went, manuka and kanuka invaded the land. Fencing was mostly constructed with black wire and matai posts. These posts, lasting only 10 to 30 years, resulted in fences of short life, necessitating much maintenance. An estimated nine miles of pine shelter belts were planted for protection, and some recovery of the blown areas resulted. By 1936 rabbits were on the increase, and by 1945 they were here in tens of thousands. I have records from 1945 to 1949 showing 104,000 killed on this farm. The better grasses were either eaten out or reduced to mere vestiges, stock deteriorated and carrying capacity dropped, while crops were difficult if not impossible to grow.

At this stage the district developed a very bad name. Much of the land came on the market, and changed hands at prices as low as 20s. per acre, 30s. for freehold without buildings, and large areas complete with buildings sold at £3, £4, or £5 per acre. Apart from a few farmers who had successfully broken in and farmed land in

this area, most of it was in sore need of development. The State bought up both developed and undeveloped land for settling 16 returned servicemen. Established farmers from other districts purchased land and proceeded to develop it. Quite a number of men bought small areas of undeveloped or partly developed land, and it was not until Marginal Lands Board assistance was given that they, too, were able to develop their land. In some cases their efforts and results have been spectacular.

Development

The problem that faced us was how, with limited finance, to convert a marginal farm into an economic unit. To succeed, we had to get rid of most of the rabbits and convert as much land as possible from poor pastures, fern and scrub land, into English grass and then increase the flock to cope with the grass. With the little money we had, we were able to purchase a crawler tractor, a semi-swamp plough, and later a set of giant discs and the usual farm implements. With this equipment and a labour force which varied but never exceeded three, we re-grassed the ploughed areas which were now reverting to scrub, and started developing the unploughed fern and scrub areas. Small, rough patches were by-passed, and these we are now developing on the second round. The plough was capable of turning under whippy scrub up to four and five feet high, and provided we ploughed the land only once or twice and did not overwork it, the risk of wind blow was reduced.

As our equipment was light, we were not in a position to smash down heavy scrub, so in the dry 1945-46 summer we burnt most of it standing, thereby killing practically all the heavy manuka. Fern and young scrub, however, soon re-covered these areas. When, years later, we were prepared to bring this area into grass, a second fire killed the young fern and scrub, and burnt most of the dead sticks from the first fire. Areas that did not burn were giant disced green, the subsequent fire burning most of the rubbish. We were, in this way, with our light equipment, able to deal with land which had once been formidable.

We have found that the soil works up much easier after a burn of standing fern and small scrub than where a similar area of green fern and scrub is disced. The burnt areas are safer, for the tractor driver can see where he is going. With small burnt sticks and no accumulation of knocked-down fern and scrub, the discs bite much deeper into the soil, and provide the basis for an easily and cheaply worked-up seed-bed. Our policy was to plough where we could, and giant disc the rest. Where the plough was used side by side with the discs, fern always recovered more quickly on the disced land.

When sowing down to pasture in the autumn, we mostly sowed turnips with the grass seed, but a crop of turnips with the grass on virgin land was a rarity. On this virgin land the grass grows

TABLE 1: DETAILS OF AREAS PLOUGHED AND SOWN TO GRASS

Season	Crop	Acres	1st Sowing of Grass	Acres	2nd Sowing of Grass	Acres
1945-46	Choumoellier	62	Grass and turnips	220		
	Barley	41				
1946-47	Choumoellier	45	Grass and turnips	216		
1947-48	Choumoellier	51	Grass and turnips	89		
1948-49	Choumoellier	82	Grass and turnips	71		
1949-50	Choumoellier	102	Grass and turnips	82		
1950-51	—		Grass and turnips	117	Grass and turnips	29
1951-52	Choumoellier	22			Grass and turnips	101
1952-53	Choumoellier	41	Grass and turnips	53	Grass and turnips	94
1953-54	—				Grass and turnips	171
1954-55	Choumoellier	73	Grass and turnips	106	Grass and turnips	75
1955-56	Choumoellier	72	Grass and turnips	74	Grass and turnips	26

reasonably well in the hollows, but elsewhere much of it yellows off, and it is not until the following December that the clovers make a strong growth and start the cycle of increasing fertility. In our early years (1946-49), rabbits were bad, and they ate out most of the better grasses, and Yorkshire fog and sorrel replaced these. With the resulting low carrying capacity, the consolidation which was essential was slowed down. We were then faced with pastures that became clover dominant with a consequent flush of summer feed and shortage of winter grass. Despite these troubles, our areas of clear land grew, and stock numbers increased.

Today, the 2,621 acres of the farm are made up as follows:

1,028 acres in sown grass or crop.
45 acres have been giant disced once.
331 acres of un-topdressed native land.
26 acres topdressed native grass.
71 acres of pines and other trees.
5 acres rocks and roads.
2 acres of buildings and yards.
1,113 acres of fern, bush, and scrub covered land, of which approximately 200 acres are capable of being giant disced.

Details of the areas ploughed and sown to grass are given in Table 1.

Within the next two years, practically all the easy land will be in grass, and we shall then be able to concentrate on the steeper country. From 1950 onwards, rabbits declined rapidly in numbers, and we embarked on a policy of re-sowing areas that had been adversely affected by rabbits. In one case we re-sowed a block which, because of lack of adequate fences, had reverted to fern. Rabbits were killed at the rate of up to 52 per acre per year, with an overall average of nearly 10 per acre. When we re-sowed these areas, we also cleaned up the rough patches that had been by-passed. As the result of experience, our present method of developing this fern and scrub covered country is as follows:

Autumn-saved pasture on land over 2,000 ft. above sea level. Radiata pine shelter belts give some protection from the prevailing strong north-west winds.

(1) Burn as much as possible the preceding summer and autumn when conditions are dry.

(2) Giant disc the area in the winter and spring.

(3) Stock with dry sheep and cattle in late summer and early autumn to control fern growth. Burn disced green scrub.

(4) Giant disc the second time in late summer, thereby killing any re-growth and any green scrub that missed being burnt and working up where the scrub had been giant disced green. A saving in costs can be made here by not discing twice, but then this is risky. The second cut with the giant discs ensures a better seed-bed.

(5) Harrow.

(6) Broadcast superphosphate on the surface at the rate of 3 to 4 cwt. per acre.

(7) Sow the seed at the rate of approximately 35 lb. per acre, from a grass seed box on the back of a Cambridge roller, the seed being buried by a set of light chain harrows fixed behind the roller.

Land Development at Present-day Costs

These costs may seem high, but they are based on the tractor hours worked at current contract rates. We have done 90 per cent. of the tractor work ourselves, and costs have actually been much less. One tractor, which cost £1,600, has done 3,690 hours and only £54 has been spent on repairs. More expensive maintenance is now due.

1. *25 acres steep and broken, originally fern and scrub, previously burnt, but with quite a lot of heavy scrub left by the fire.*

CULTIVATION

	£	s.	d.	£	s.	d.
1st Giant discing—48 hours @ £3	144	0	0			
2nd Giant discing—32 hours @ £2	64	0	0			
Harrowing—6 hours @ £2	12	0	0			
Sowing manure—4½ tons by contract	11	5	0			
Rolling and sowing—8 hours @ £2	16	0	0			
Total for 25 acres	247	5	0			
Cost per acre				9	17	9

SEED

	£	s.	d.	£	s.	d.
20 lb. P.P. perennial ryegrass	1	5	0			
4 lb. Cocksfoot certified	1	12	0			
5 lb. Undressed clovers		3	9			
2 lb. Pedigree white clover		15	6			
1 lb. Cowgrass certified		6	6			
1 lb. Montgomery red certified		7	0			
	4	9	9			
Cost per acre				4	9	9

MANURE

	£	s.	d.	£	s.	d.
4½ tons—@ £9 6s. 0d.	41	17	0			
Cartage	9	1	6			
Total for 25 acres	50	18	6			
Cost per acre				2	0	9
Total cost per acre excluding fencing				16	8	3

2. *35 acres steep and broken into nine separate areas. Original fern and scrub previously burnt, but with four acres unburnt.*

CULTIVATION

	£	s.	d.	£	s.	d.
1st Giant discing—52 hours @ £3	156	0	0			
2nd Giant discing—45 hours @ £2	90	0	0			
Harrowing—11 hours @ £2	22	0	0			
Topdressing—8 tons @ £2 10s.	20	0	0			
Rolling and sowing—14 hours @ £2	28	0	0			
Total for 35 acres	316	0	0			
Cost per acre				9	0	7

SEED

	£ s. d.	£ s. d.
20 lb. P.P. perennial ryegrass	1 5 0	
4 lb. Cocksfoot certified	1 12 0	
5 lb. Undressed clover	3 9	
2 lb. Pedigree white clover	15 6	
1 lb. Cowgrass certified	6 6	
1 lb. Mongomery red certified	7 0	
12 oz. Turnips	3 7	
	4 13 4	
Cost per acre		4 13 4

MANURE

	£ s. d.	£ s. d.
8 tons—@ £9 6s. 0d. per ton	74 8 0	
Cartage	16 2 8	
Total for 35 acres	90 10 8	
Cost per acre		2 11 5
Total cost per acre excluding fencing		16 5 4

3. *40 acres gently rolling. Had been in choumoellier. Costs more typical of easy fern country.*

CULTIVATION

	£ s. d.	£ s. d.
Giant disc—52 hours @ £2	104 0 0	
Tandem discs with harrows—		
14 hours @ £2	28 0 0	
Topdressing—9 tons	20 0 0	
Rolling and sowing—		
12 hours @ £2	24 0 0	
Total for 40 acres	176 0 0	
Cost per acre		4 8 0

SEED

	£ s. d.	£ s. d.
26 lb. P.P. perennial ryegrass	1 12 6	
4 lb. Cocksfoot certified	1 12 0	
3 lb. Pedigree white clover	1 3 3	
1 lb. Montgomery red certified	7 0	
1 lb. Cowgrass certified	6 6	
12 oz. Turnips	3 7	
	5 4 10	
Cost per acre		5 4 10

MANURE

	£ s. d.	£ s. d.
9 tons—@ £9 6s. 0d. per ton	83 14 0	
Cartage	18 3 0	
Total for 40 acres	101 17 0	
Cost per acre		2 10 6
Total cost per acre excluding fences		12 3 4

The present high prices, particularly for wool, have been of the utmost assistance, and like everyone else, we are trying to put as much money back into the land as possible.

Examples of costs per acre of early developmental work from previous cover to grass using cheaper seed mixtures and only 2 cwt. per acre of manure are as follows:

	£ s. d.
50 acres undulating, virgin fern and manuka	11 8 0
38 acres gently undulating, virgin fern and manuka	8 19 0
94 acres undulating to steep, virgin fern and manuka	8 2 0
45 acres gently undulating, previously in grass	8 7 0
50 acres gently undulating, previously in grass	7 16 0
75 acres steep, fern and scrub land	10 14 0

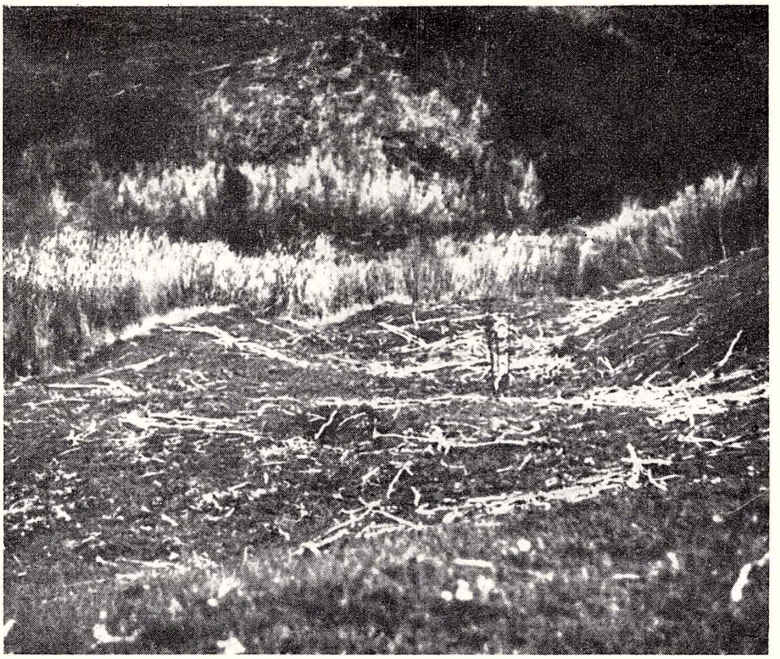
Fencing

Fencing is a very expensive item and is still a headache. Hunter chain fencing, just as efficient as other fences and more easily repaired, is the obvious answer in this country. We use a great deal of it, and all our new fences are of this type. The cost varies from about £5 to £9 per acre, depending on the size of the paddock. We are forced to rely on many miles of the original fencing, which is far from stock-proof. There are 31 paddocks here, varying from 10 acres to 250 acres, and it is our policy to subdivide the larger paddocks. For ease of management, I believe 20 acre paddocks would be ideal.

Steeper Land

The improvement of the steeper land is largely a matter of the future as far as we are concerned. We have been limited, as most farmers are, by finance, and have found that returns have been quickest and greatest from those areas that have been worked-up and sown down, as against the steep areas that have first to be cut by hand. With the advent of the manuka blight, we have something worth thousands of pounds to us. This steep land can be developed by modern methods—burning, sowing, topdressing from the air, subdivision, and stocking by dry sheep and cattle.

Where, for various reasons, we consider the land too steep to be in grass, we have started to plant trees, mostly radiata pine, but also macrocarpa, western red cedar, redwood, and some Douglas fir. As to be expected, the pines are growing strongly. Within thirty years these



Young grass coming up through the giant disced burnt and scattered remains of the original heavy scrub covering.

will yield a very handsome return. The trees planted in the steeper areas are not only preventing erosion, but are a long-term crop and a payable one too.

Stock

In 1945 a State valuation gave an estimate of carrying capacity under efficient management of 1,600 sheep and 160 head of cattle. Because of the hordes of rabbits at that time, efficient farming was impossible, and the actual carrying capacity was reduced to about 1,100 sheep and 30 head of cattle. We are now wintering 3,750 sheep and 150 head of cattle, and these are far better stock and much better fed than the original ones. Because of an additional area of 74 acres sown to grass this year, there will automatically be an increase in stock numbers next year. Lambing percentages have steadily risen until we now expect about 100 per cent. In 1945 we docked 600 lambs, none of which were fattened on the farm. This last season we docked 3,240 lambs out of 3,180 ewes that went to the ram; this despite losses from sleepy sickness.

Stock figures can be very misleading in our particular case, for by an agreement we have always been able to build up stock numbers in the summer to eat off surplus feed from clover dominant pastures. This agreement worked well because in the winter we were able to

reduce the number of sheep carried. Government development schemes match pasture growth on similar type pastures by buying dry stock and killing off many of them fat in the autumn.

By shutting up a large area of un-topdressed native grass in the summer, we have now adequate supplies of cattle feed which took no labour to conserve and no labour to feed it out. Choumoellier stalks help in feeding the cattle in the winter.

Sheep Management

After coming off the winter crops and young grass towards the end of July, the ewes which are due to start lambing by August 24 are usually sorted by udder development into early, middle, and late lambing ewes. Though not perfect, this system works well, and saves a lot of time. The early lambing ewes go on to the best pastures. By having all the sheep on crops, our pastures get a spell, and grow an appreciable amount of fresh feed.

At intervals during lambing, the ewes and lambs are shedded out and docked when the paddock is full. The ewes and lambs generally remain set stocked in their paddocks until shearing, which takes place about the end of November and beginning of December, when the ewes are shorn and all lambs crutched. They go back to their paddocks until weaning about the end of January or the beginning of February, when all Southdown cross and Romney wether lambs are gone through for fats.

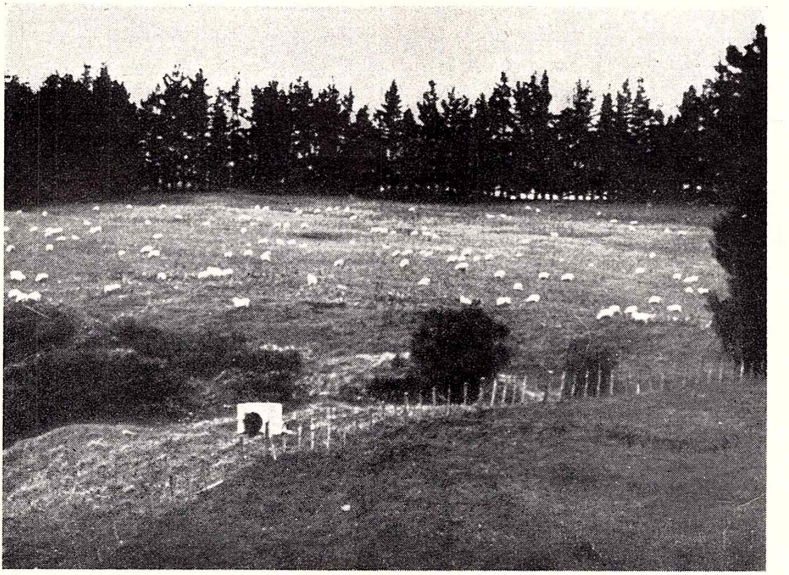
In the past we have always sent our store lambs down country for fattening on crops, but this year we decided to try fattening them on grass and clover. The remaining 600 wether lambs were divided into two mobs; 250 went into a good ryegrass-white clover paddock with grass about four to six inches long; the other 350 went into a red and white clover dominant paddock of 41 acres and just one year out of scrub and fern. The lambs that went into the clover, which was up to one foot high, actually fattened better than those on old pasture.

Details of the killing weights of lambs are given in Table 2.

All fat stock is sold on owners' account and apart from the period immediately following the big wharf strike in 1950-51 we have found this method of selling profitable, especially with our more heavily-woolled Romney lambs, which slipe between 3.0 and 3.6 lb. of wool.

TABLE 2: KILLING WEIGHTS OF LAMBS.

Drafting Date	Off Mothers	Off Grass and Clover	Lambs Remaining	Average Carcase Weight (lb.)
January 24	16	—	—	34.0
January 26	712	—	—	37.43
February 1	515	—	—	38.2
April 9	—	433	163	36.50



Good seed, adequate superphosphate, and controlled stocking with big mobs have rapidly built up fertility and carrying capacity.

After weaning, the ewes are used in mobs for cleaning up pastures until shortly before the rams go out, when they are divided into old and cull ewes which go to the Southdown ram, mixed-age ewes, and two-tooth ewes, and flushed on the spelled paddocks. Mob stocking —a loose form of rotational grazing—goes on until the ewes are crutched in late June and then they go on to crops. Hoggets are also being mob stocked but not so heavily as the ewes.

The carrying capacity varies a great deal from paddock to paddock, depending on past treatment, and the length of time it has been out of scrub and fern. The oldest and best paddocks will lamb five ewes per acre and fatten more than 50 per cent. of the wether lambs. A capacity of four ewes with their lambs is possible over much of the older pastures; the younger paddocks do three ewes, and in cases less. The ultimate carrying capacity may be five sheep per acre under known techniques.

Unfortunately, I am unable to give details of the wool clip. The wool is often dirty with pumice dust, and wool weights are only average. Footrot is rare, and facial eczema has yet to make its first appearance.

Cattle are used only for cleaning up pastures, and their use has been limited by lack of efficient fences. Cattle have been brought in each year during the summer for the cleaning up of pastures.

Superphosphate

When we took over the farm, the yearly ration was five tons. From an annual topdressing rate of 2 cwt. per acre, we have, for

the past two years, increased this to 3 cwt. per acre, applied in one single dressing. The increased pasture growth resulting has certainly warranted the heavier topdressing rate. Costs of topdressing are given in Table 3.

Because it has suited us and our pocket, we have used the bulk spreader, and tractor and spreader.

TABLE 3: TOPDRESSING COSTS

Method	Cartage per ton	Superphosphate per ton	Bags	Spreading Cost per ton	Total
	£ s. d.	£ s. d.		£ s. d.	£ s. d.
Bulk Spreader	2 0 4	8 1 6	No bags	2 0 0	12 1 10
Tractor and Spreader	2 0 4	9 6 0	In bags	2 0 0	13 6 4
Aircraft	2 0 4	8 1 6	No bags	3 0 0	13 1 10
Aircraft	2 0 4	9 6 0	In bags	3 0 0	14 6 4

* * *

The essence of this work has been the raising of the level of fertility by making full use of the clover/phosphate/stock fertility cycle. Only the best of clover and grass seed will produce a pasture capable of carrying a sufficient number of stock to ensure consolidation. Controlled grazing with its shower of dung and urine rapidly builds up fertility. The regular use of superphosphate boosts the clovers, which, in turn, provide the nitrogen to stimulate the grasses and so establish a balanced pasture which will grow good stock feed throughout the year. Good fences are essential to give adequate control over stock, pastures, and fern. Finally, to avoid any gross mistakes, the planning and financing of such developmental work as this must be carefully worked out beforehand.

In giving this story of the development of a marginal Hawke's Bay farm owned by my brother and myself, I cannot help but feel that I am standing on the shoulders of others. First, I owe a debt to Massey College and its lecturers who, in three short years, not only taught me a vast store of practical knowledge, but, more important still, taught me a method of thinking about and evaluating farming problems that has stood us in good stead in the struggle to become financially successful farmers. Secondly, there are those farmers who have gone before us on this property, for no matter whether their efforts were crowned with lasting financial success or not, many of their works remain as a basis on which we can build. Then, there are those research workers, the Departments of Lands and Survey and Agriculture, and the farmers who have evolved techniques for the development of fern and scrub-covered pumice lands of low fertility. Lastly, this work would not have been possible without family assistance and co-operation.

DISCUSSION

Q:: *Have you used any lime?*
A:: We have had excellent results without lime. To put on one or two tons of lime to the acre, with a haulage of 35 miles, is far too expensive, especially when we are getting satisfactory results without any.

Q:: *Have you used any lime reverted super?*
A:: No. The soil tests show that we have an acid soil which probably would benefit by lime, but when the cost is gone into it does not seem worthwhile.

Q:: *Have you any future plans for the steeper country now infested with manuka blight?*
A:: Yes. As soon as the blight becomes sufficiently spread—and it is only spreading now—we intend to oversow, stock with dry sheep and cattle, fence it into smaller blocks, and cut down the kanuka. We have a lot of kanuka in the area, which is not affected by manuka blight.

Q:: *How did you get rid of the rabbits?*
A:: That is a problem which is largely wrapped up with the killer board. I was a member of the killer board. However, we got down on the rabbits just before the killer board was established and we reduced their numbers chiefly by the use of strychnine and the use of pollard poisoning in the latter days. Once the killer board came in and took the weight off our shoulders, it has kept the rabbits in control. It was the use of strychnine and phosphorized pollard which proved to be, in the end, the easiest and best to use.

SUMMERS

GALVATITE

GALVANISED SHEET

THE MOST MODERN GALVANISING TECHNIQUE

Recently at the British Iron and Steel Research Association's Laboratories it was shown that Galvanised Sheets produced by modern continuous process have a much more uniform coating than the general run of hot dipped Galvanised Sheets, and as a result the duration of exposure until rust first appears is likely to be greater, the expected advantage for a given coating weight in favour of the continuous method being up to 50 per cent.

JOSEPH NATHAN & CO. (N.Z.) LTD.

WELLINGTON AUCKLAND CHRISTCHURCH

INDEX TO ADVERTISERS

A.C.I. Plastics Pty. Ltd. 160
Bank of New Zealand 136
Batenburg, L. & Co. Ltd. 239
Burns, John & Co. Ltd. 106
Cave, F. W. Ltd. 248
Cooper, McDougall & Robertson (N.Z.) Ltd. 56
Dalgety & Co. Ltd. 52
Elastrator Co. Ltd., The 54, 247
Elco Ltd. 118
Europa Oil (N.Z.) Ltd. 249
Farm Chemicals Company 45
Farmers Co-op. Wholesale Federation (N.Z.) Ltd. 107
Farmers Industries Ltd. 214
Fletcher, W. & R. (N.Z.) Ltd. 162
Ford Motor Co. of N.Z. Ltd. 211
General Motors N.Z. Ltd. 137
Goodyear Tyre & Rubber Co. of N.Z. Ltd., The 202
Gough, Gough & Hamer Ltd. 44
Guardian Trust & Executors Co. of N.Z. Ltd., The 200
Hamer Electrical Co. Ltd. 198
Imperial Chemical Industries (N.Z.) Ltd. 138, 201
International Harvester Co. of N.Z. Ltd. 108
Major Steel Products Ltd. 199
Manning, R. P. M. & Co. Ltd. 182
Marton Sash, Door & Timber Co. Ltd., The 46
Nathan, Joseph & Co. Ltd. 117, 180, 263, 264
Nicholas Products Pty. Ltd. 147
Norwood, C. B. Ltd. 240
Reckitt & Colman (N.Z.) Ltd. 178
Reid & Gray Ltd. 179
Sargood, Son & Ewen Ltd. 181
Satterthwaite, A. M. & Co. Ltd. 212
Smith, Frederic, W. Ltd. 53
Summit Products Ltd. 135
Todd Motors Corporation Ltd. 148
Tattersfield Ltd. 161
Watkins, Ivon, Ltd. 250

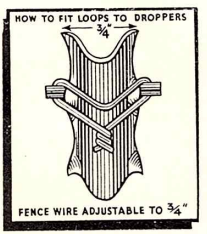
UNIVERSAL ALL STEEL

"VAREXO"

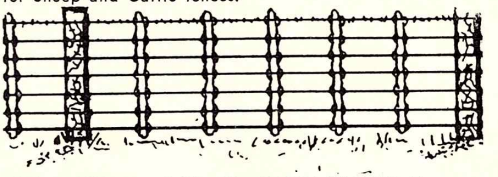
CORRUGATED EDGED

FENCING DROPPERS

15 gauge available in 39", 42", 45", and 48" lengths. 16 gauge, 1¼" section available soon in 39" and 42" lengths. The saving of weight makes this lighter dropper particularly attractive for back country work.



VAREXO DROPPERS are suitable for use with any type of Fercing Standard, Concrete or Wooden Post, and can be used with both Plain and Barbed Wires. Additional droppers can be attached to any existing fence, and additional wire can be fixed in any position and attached to existing droppers. The Ideal Dropper for Sheep and Cattle fences.



See them at

STOCK AND STATION AGENTS EVERYWHERE

SOLE NEW ZEALAND AGENTS:

JOSEPH NATHAN & CO. (N.Z.) LTD.

WELLINGTON AUCKLAND CHRISTCHURCH